

NORTH CAROLINA SCIENCE AND TECHNOLOGY RESEARCH CENTER

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NASA CR107625

FINAL REPORT ON A
REGIONAL TECHNOLOGY TRANSFER PROGRAM

**CASE FILE
COPY**

Contract NSR 34-007-006

Period Covered: June 1, 1968 -- August 31, 1969

F I N A L R E P O R T O N A
R E G I O N A L T E C H N O L O G Y T R A N S F E R P R O G R A M

NORTH CAROLINA SCIENCE AND TECHNOLOGY RESEARCH CENTER

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Post Office Box 12235
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Contract NSR 34-007-006

Period Covered: June 1, 1968 -- August 31, 1969

CONTENTS

	Page
I. INTRODUCTION - - - - -	1
II. STRC ORGANIZATION - - - - -	2
A. Purpose - - - - -	2
B. History - - - - -	4
C. University Affiliations - - - - -	4
D. NASA Support - - - - -	5
E. STRC Staff - - - - -	6
F. Administrative Personnel - - - - -	9
G. Plant Location and Facilities - - - - -	10
III. SERVICES TO CLIENTS - - - - -	12
A. Applications Engineers - - - - -	12
B. Clerical Staff - - - - -	13
C. Relationship of Applications Engineer to Client - - - - -	14
D. Services Available - - - - -	18
IV. MARKETING - - - - -	38
A. Mission - - - - -	38
B. Orientation - - - - -	38
C. Personnel - - - - -	38
D. Methods - - - - -	39
E. Tools - - - - -	47
F. Client Composition - - - - -	49
G. Fee Schedule - - - - -	58
V. COMPUTER ACTIVITIES - - - - -	62
A. Information Retrieval - - - - -	62
B. STRC Inverted Search System - - - - -	63
C. Inverted vs Linear Searches - - - - -	64
D. Cost Considerations - - - - -	65
E. Logical Capabilities - - - - -	65

V.	COMPUTER ACTIVITIES (con't)				
	F. Saving Hits	-	-	-	66
	G. Other Options and Limitations			-	66
	H. Bibliographic Support			-	67
	I. STRC Data Base	-	-	-	68
VI.	SPECIAL PROJECTS	-	-	-	69
	A. Graduate Student Program			-	69
	B. STS Searches	-	-	-	75
	C. Marketing Study			-	77
	D. Cost Study	-	-	-	79
	E. General Assembly			-	80
VII.	IMPACT REPORTING	-	-	-	80
	APPENDIX OF EXHIBITS	-	-	-	105

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1	Organization Chart; State of North Carolina and Science and Technology Research Center (STRC)	3
2	Organization Chart; Staff of STRC	6
3	STRC Staff Growth and Change	8
4	General Search Strategy	23
5	Computer Printout Sample	23
6	Production Cycle on Retrospective Search	25
7	Service to Industrial Clients	28
8	Ten Most Used Categories	32
9	Use of STAR Categories 25 and 30	34
10	Time Lag - Searches to Documents	34
11	Documents by Category	35
12	Production Cycle on Searches from Other RDC's	37
13	STRC Clients by Geographical Location	52 - 53
14	STRC Receipts by SIC Code	55
15	STRC Clients by Company Size (Number of Employees)	56
16	STRC Client Composition	56
17	STRC New Subscriptions and Renewals	57
18	STRC Billings by Contract Quarter	60
19	Search Parameters	67
20	Composition of Computer File	69

ABSTRACT

North Carolina Science and Technology Research Center,
Research Triangle Park, North Carolina.
FINAL REPORT ON A REGIONAL TECHNOLOGY TRANSFER PROGRAM,
June 1, 1968 -- August 31, 1969
Contract NSR 34-007-006

This report discusses in detail the operation of an experimental NASA-sponsored Regional Dissemination Center in the southeastern United States from June 1968 through mid-1969.

Three factors set the North Carolina Science and Technology Research Center apart from other RDC's - its orientation with state government (rather than a university), the predominantly agrarian economy of the vast area it serves, and its emphasis on the development of more sophisticated software for computerized information retrieval. Each of these factors has influenced the growth and effectiveness of the Center, and its impact, through the Technology Utilization Program, on industry in the Southeast.

Through the Graduate Student Program, STRC has pioneered in providing low-cost literature searches in technical and scientific fields to advanced degree candidates in 23 southern universities. This support strengthens the university's graduate program and funnels new technology into industry through the scientists and leaders of tomorrow.

Several STRC case histories are related at the conclusion of the report to illustrate the effectiveness of a technology utilization program in this particular geographic area.

NORTH CAROLINA SCIENCE AND TECHNOLOGY RESEARCH CENTER

ANNUAL REPORT

I. INTRODUCTION

This report is submitted in fulfillment of the requirements of National Aeronautics and Space Administration Contract No. 34-007-006.

The period of performance as set forth in the contract was June 1, 1968, through May 31, 1969; however, by agreement dated June 13, 1969, the termination date was extended to August 31, 1969. This report covers the entire fifteen months of the contract period, although for purposes of comparison and analysis we have also included statistical data for the period beginning January 1, 1966, to the termination date of the present contract.

The report is divided into seven sections: Section I contains the Introduction; Section II presents the background of the North Carolina Science and Technology Research Center, its orientation to the State of North Carolina and NASA, and its facilities; Section III, IV, and V describe in detail the Regional Dissemination Center operation at STRC, including marketing and computer activities; Section VI discusses special projects undertaken; and Section VII investigates some impact of STRC on its clients. The Appendix contains samples of forms, letters, and printed matter used by STRC.

II. STRC ORGANIZATION

A. Purpose

The economy of North Carolina traditionally has been based on agriculture (primarily cotton and tobacco) and textiles--both notorious for low wage scales and seasonal employment. A third industry, furniture, is also at the bottom of the wage scale. In 1964 the average hourly earnings in manufacturing industries in North Carolina were the lowest of any in the nation and, in addition, the national growth rates in the basic industries were also below average. The need to strengthen the state's economic base was obvious, and a number of ways of doing this were suggested, several of which were adopted.

One method, advocated by the Governor's Scientific Advisory Committee, was maximum participation in the nation's space-age advancements, and in particular the attraction of those science-based industries, such as chemical, electronic, and nuclear energy, which are among the best paying. But first the state's scientific capabilities needed to be improved to provide a compatible environment. To assist in accomplishing this, the 1963 General Assembly, enacting into law the recommendations of the Advisory Committee, created the North Carolina Board of Science and Technology and its subsidiary, the Science and Technology Research Center (STRC).

The Board, composed of fifteen members chosen from leaders in the scientific, academic, business and legislative communities, is the administrative unit. A small staff carries out the directives of the Board, which makes grants for research and oversees the activities of STRC.

STRC, by legislative decree, is directly responsible for the operation of a program to encourage industry in "screening and identifying research results for possible industrial application"¹ Close cooperation with the National Aeronautics and Space Administration, the Atomic Energy Commission, educational institutions, and the Research Triangle Institute is delineated in the statute to ensure maximum contact with all qualified sources of new technology.

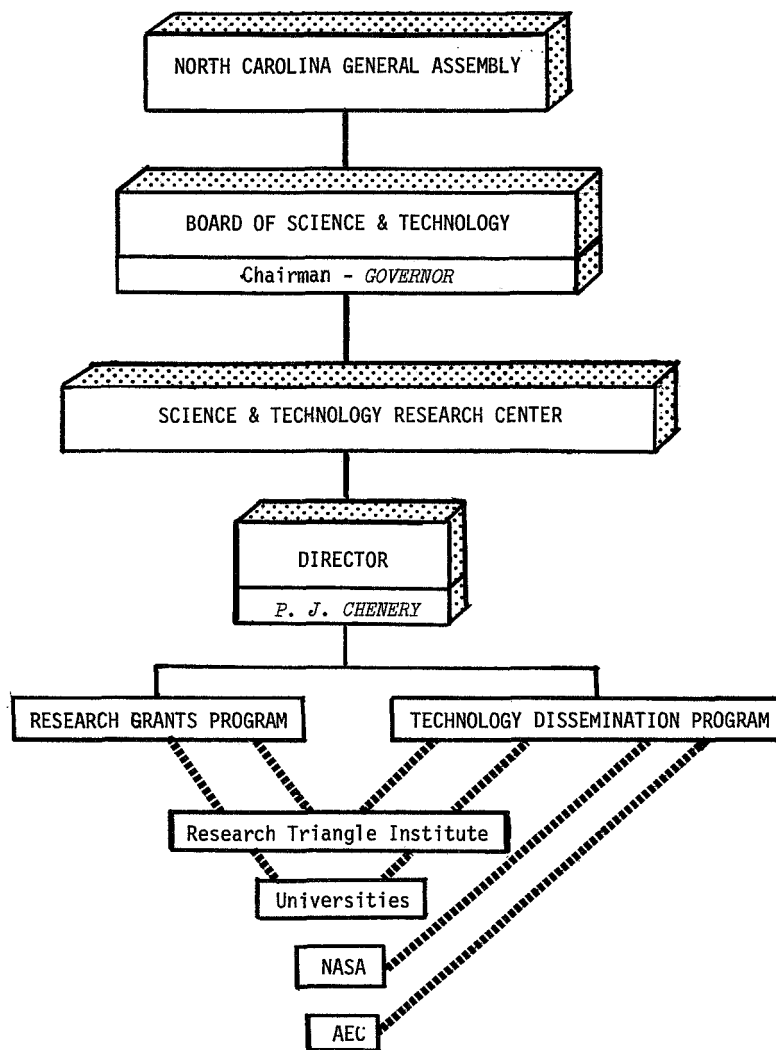


Figure 1

¹ General Statutes of North Carolina 143-380 (6)

B. History

To put the program into immediate effect, the 1963 General Assembly approved funds to operate the dual agency for the 1963-65 biennium, and additional funds for a building to house it. A director, Peter J. Chenery, was commissioned by Gov. Terry Sanford and recruiting was then begun for a professional staff to carry out the mandates of the legislators.

Initially, STRC was housed at the Research Triangle Institute, but it quickly outgrew these temporary quarters and larger facilities were leased in Raleigh until completion of the STRC building in Research Triangle Park in December 1965.

C. University Affiliations

From its inception, STRC's relationship with the three Triangle universities* has been cordial and cooperative. Each of the universities is represented on the Board of Science and Technology by two members and consultants from the universities are on call for problems requiring the services of specialists in highly technical fields. Two STRC staff members are also on the faculty of North Carolina State University. Through its information retrieval facilities, STRC has served both faculty and graduate students in research projects.

The Research Triangle Institute, a non-profit, public-service research organization, was created through cooperative

* University of North Carolina at Chapel Hill, Duke University at Durham, and North Carolina State University at Raleigh.

efforts on the part of academic, governmental and industrial leaders throughout the state. Its Board of Governors draws half its membership from the administration and faculty of the three Triangle universities, and the liaison between the Institute and the universities has resulted in close coordination of research programs. The Institute, with its strong university affiliations, is also represented on the Board of Science and Technology, and the two organizations draw on each other's resources as needed.

D. NASA Support

Shortly after the formation of the Board of Science and Technology, a proposal was made to NASA for the establishment of a Regional Dissemination Center in North Carolina. The proposal was the result of joint action taken by the three Triangle universities, the Research Triangle Institute, and the Board. In June 1964, a contract was signed and STRC, under the direction of the Board, was selected to administer and carry out the RDC program.

Designed initially to serve North Carolina industry, the program now covers the entire Southeastern United States, from the Potomac River south to Florida, west to include Louisiana and then northward through the eastern part of Tennessee to Virginia and West Virginia. (See maps, pp. 52-53.) During the years from June 1964 through August 1969, the staff of STRC has grown to include engineers representing each of the major disciplines, a marketing division, information retrieval or computer section, document and reproduction services, a technical writing group, and of course, secretarial assistants.

NASA contracts under which this RDC program has been carried out are:

NAS4-235	June 1, 1964 to March 31, 1967
NSR 34-007-003	April 1, 1967 to May 30, 1968
NSR 34-007-006	June 1, 1968 to August 31, 1969

E. STRC Staff

Summary

The following chart shows the supervisory lines and areas of functional responsibility in STRC.

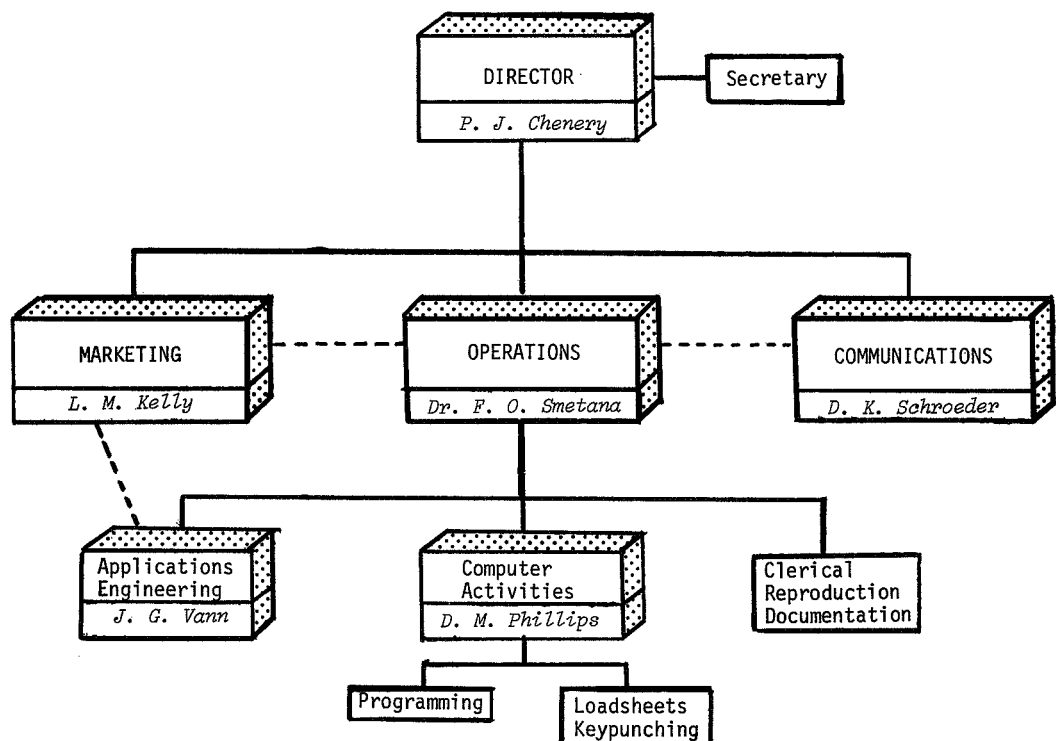


Figure 2

It should be noted that all personnel at STRC, with the exception of the director, come under the State Personnel Act of 1954. Job classifications and salary ranges are set in accordance with State Personnel policies and the size of the STRC staff is controlled in accordance with the budget established for the agency by each biennial session of the General Assembly. Titles for each job classification as given in this report reflect, to the best of our ability, a description of the actual work performed by that staff member; state classifications will not necessarily conform. For example, the assistant librarian is classified by State Personnel as a Typist II, although she performs only a very limited amount of typing in connection with the ordering of documents.

Because of budgetary controls regarding the establishment of permanent positions, it is easier for us to employ several qualified people on a temporary basis (either to carry out one particular project or to assist an over-burdened staff member through a load peak) than it is to create another permanent position opening. With the proximity of the three universities and the state capitol, qualified applicants are in good supply.

STRC STAFF TOTALS

August 31, 1969

Permanent		19
Professional	9	
Clerical	10	
Full-time Equivalents		22.5
Professional	12.5	
Clerical	10	

As the entire range of programs undertaken by STRC is experimental, the composition of the staff, both in number and type, has, of necessity, changed to some extent since the original organization in 1964. At that time, one person, with a background in mathematics, handled all computer activities. At the present time, this department consists of five full-time staff members with two others on call as needed. Also, as in most organizations, job descriptions change even when the personnel remain static. As the RDC program grows, evolves, is refined, and/or changes direction, the activities and responsibilities of various staff members will reflect these changes.

GROWTH AND CHANGE IN THE STRC STAFF
(January 1, 1966 - August 31, 1969)

<u>January 1, 1966</u>	<u>June 1, 1968</u>	<u>August 31, 1969</u>
<u>PERMANENT STAFF</u>	<u>PERMANENT STAFF</u>	<u>PERMANENT STAFF</u>
Director (Secretary)	Director (Secretary)	Director (Secretary)
Technical Editor (Secretary)	Ass't. Director/ Marketing	Ass't. Director/ Marketing
TU Manager/Engineer Appl. Engrs. (5)	Technical Editor (Secretary)	Technical Editor
Computer Specialist Technical Ass't. Librarian	TU Manager/Engineer Appl. Engrs. (3)	TU Manager/Engineer Appl. Engrs. (3)
Typists (2)	Programmer Technical Ass't.	Systems Analyst Programmer Technical Ass't.
Clerks (2)	Ass't. Librarian	Keypunch & TWX opr.
	Typists (2)	Secretaries (3)
	Clerks (3)	Ass't. Librarian
	<u>PART-TIME</u>	Clerk-Typists (2)
	Ass't. Director/ Operations	<u>PART-TIME</u>
	Information Specialist	Ass't. Director/ Marketing
		Information Specialist
		Ass't. Editor

Figure 3

F. Administrative Personnel

Peter J. Chenery, director, is responsible for the overall administration of STRC, answerable to the Governor of North Carolina, who serves as Chairman of the Board of Science and Technology. Within the guidelines of the current NASA contract and those of state government, Mr. Chenery determines the scope and direction of STRC activities. He is a graduate of Harvard University, has served as a Research Associate at Massachusetts Institute of Technology, holds a number of patents in the fields of flight control equipment and textile machinery. Prior to his position with STRC, Mr. Chenery was director of research and manager of the Contract Products Division of Wright Machinery Company, a division of Sperry Rand Corporation.

The assistant director for operations, Dr. F. O. Smetana, is also professor of mechanical and aerospace engineering at North Carolina State University. During the academic year, Dr. Smetana serves the Center one day per week on a consulting basis; during the summer months he is on a three-day per week basis.

Dr. Smetana is directly responsible for the efficient flow of service to clients under the Technology Utilization Program, and for the execution of special experimental projects undertaken by STRC from time to time. He assists in coordinating computer activities, applications engineering, and personnel matters.

L. M. Kelly, assistant director for marketing, joined the staff of STRC in August 1967 as its first full-time salesman following his retirement as professor of military science and

head of the Army's ROTC unit at North Carolina State University in Raleigh. A graduate of the Command and General Staff School, Mr. Kelly served in the Army's Research and Development program and as deputy civil administrator in the Ryukyu Islands.

As head of marketing for STRC, Mr. Kelly is responsible for evaluating market potentials, planning and coordinating all marketing activities, as well as personally contacting those industries and organizations identified as possible users of STRC services. A comprehensive discussion of the full marketing program is given in Section IV.

Personnel in other divisions will be discussed in connection with their respective areas of responsibility.

G. Plant Location and Facilities

Research Triangle Park

The statute creating the Board and STRC specifically located the STRC building in Research Triangle Park. At that time (1963) the Park was four years old and had only three tenants, but the reasoning behind the action of the General Assembly was obvious - support for the Park through a state agency and support for that agency from the Research Triangle Institute and other tenants of the Park, as well as the neighboring universities. Their faith was justified, to the extent that at this time there are 10 research organizations quartered in the Park, and six more have purchased sites or are building. These are all, without exception, research-oriented, as manufacturing is permitted only on the peripheries of the Park, and STRC lists seven clients among its neighbors. Employee population of the Park at the close of

this report period is over 5,500. Although for proprietary reasons, interchange between employees of the various tenants is not encouraged, our relationship with individual organizations is cooperative.

The Park provides a very pleasant rural setting, easily accessible from any of the three Triangle cities, as well as the Raleigh-Durham Airport, a ten-minute drive by car.

The state of North Carolina owns and maintains the building housing STRC, and the nine-plus areas on which it is situated; however, 6,450 square feet of the total building area (approximately 22,000 square feet) is leased to the Triangle Universities Computation Center, and another 1,215 square feet is under lease to the Research Triangle Park Post Office. The availability of both of these facilities within the STRC building has been an asset to our operations.

At the present time, STRC has over 350,000 abstract cards on file, plus approximately 150,000 microfiche, and a hard copy library with 504 linear feet of shelf space. A separate room houses reproduction equipment, including a Xerox Model 2400 electrostatic copier, a Recordak Model 1824 Reader-Printer used to reproduce hard copy from microfiche, and Atlantic Model 609 Micro Folio equipment for making duplicate microfiche. Computer and communications equipment in use includes an IBM Model 029 Key punch, a teletype computer terminal, and a second teletypewriter (TWX) used for communication of search and document requests and search results to other Centers.

III. SERVICES TO CLIENTS

A. Applications Engineers

The hub of the Technology Utilization Program at STRC is the staff of applications engineers who are the liaison between the industrial community and STRC operations. An attempt is made to have on the staff one qualified graduate engineer with at least five years' industrial experience in each of the major disciplines represented by industry in this geographical region.

At the present time, the permanent engineering staff consists of a technology utilization manager, who has been with the program from the beginning, and three other engineers. We have been actively seeking a second chemical engineer since early Spring.

Technology Utilization Manager, J. Graves Vann, Jr., B. E. in ceramics, M.S. candidate in metallurgy and business administration at North Carolina State University, was employed in ceramic engineering, precision motor production, and management of a platinum works before joining STRC. He is responsible for serving those clients whose interests and needs lie within the areas of ceramics, metallurgy and machinery.

Industrial subscribers in the field of textiles and chemistry are served by A. W. Lockwood, Phi Beta Kappa graduate of Furman University. Mr. Lockwood has worked on man-made fiber development and production for such giants as American Enka, Monsanto (Chemstrand Research Center) and B. F. Goodrich Chemical Company. He holds several patents and is the author of a number of technical articles and reports on various aspects of man-made fibers.

T. R. Potter, B.E.E. with high honors from North Carolina State University, was formerly employed by Bell Telephone Laboratories on projects dealing with guided missile systems, passive sonar submarine detection, and electronic switching systems. Prior to joining STRC he also served as project engineer and manager of production engineering for two smaller electronics firms. He assists STRC clients with problems involving electrical engineering and electronics.

C. Leon Neal, B.S.M.E. with high honors from NCSU and M.S.A.E. from Purdue University, spent several years with Cornell Aeronautical Laboratories before joining STRC. He has done research in such divergent fields as blast shelters, helicopter blades, and solid-propellant rockets. Mr. Neal serves STRC clients in the areas of mechanical and aerospace engineering.

During the summer of 1969, a doctoral candidate in biomedical engineering at the University of North Carolina at Chapel Hill assisted the regular staff in preparing and evaluating searches. Michael J. Ackerman, B.S. in biology from Hofstra and M.S. from Clark University, was occupied principally with preparing search strategies and evaluating output on selected subjects for searches performed in cooperation with the North Carolina State Technical Services Program. (See Section VI)

B. Clerical Staff

STRC lists four secretaries on its clerical staff, and with one exception all are four-year college graduates. All are also, of course, much more than secretaries. One serves as coordinator of the Graduate Student Program, one serves as office manager as well as MT/ST operator and secretary to the engineering staff, and

a third combines receptionist-switchboard duties with that of being secretary to both the marketing director and technical editor. The director's secretary handles all travel authorizations and reservations, personnel papers, and a multitude of other most necessary details.

The mechanical aspects of processing computer printouts, pulling and refiling abstracts, and reproducing documents are handled by two clerk-typists under the supervision of the office manager. The TWX operator and the two clerk-typists exchange assignments and assist each other in the two departments as the work load demands. Document orders and the "hard copy" library are the responsibility of the assistant librarian.

C. Relationship of Applications Engineer to Client

The consensus at STRC is that it is almost impossible to place too much emphasis on the personal relationship between the subscribing client and the applications engineer. Repeated case histories have underscored the same pattern: that a client's usage of STRC services is directly related to the confidence he has in STRC's capabilities and discretion, and that in turn is a reflection of the relationship developed by the applications engineer with that client.

It is axiomatic that an engineer with on-the-job experience in a particular field is more sensitive to the problems, technology needs, and interests of that industry than someone with academic background only. The larger users of STRC have remarked that the chief asset of the technology utilization program is the personal interest of STRC engineers and the custom-tailored service that the company receives as a consequence. The applications engineers

also find they can answer a client's inquiries and select material in a much shorter length of time and with a much greater degree of relevancy if they have a personal man-to-man relationship with the scientist or industrial engineer who will be using the material. Although in most of the larger companies, the prime contact is the technical librarian, STRC engineers have found it extremely valuable to work with the requesting engineer before actually writing a search. The transition in wording from the engineer to the librarian to the STRC engineer often defeats the purpose of the search.

Again, engineers in industry are often not too knowledgeable about computerized information retrieval; the terms they give the librarian to be searched may not conform at all to NASA thesaurus terms and an engineer's guess at synonyms may be completely away from the point. Direct conversations between the two engineers help clear the thinking of the industrial engineer and enable the STRC applications engineer to advise the client if a search on a particular topic will be productive. If the search is then run, it will, in most instances, have a much higher degree of relevancy than one run without such personal contact.

In some instances, the cause of a lack of rapport with STRC lies initially with the client. Often he is wary of divulging proprietary information, even to someone supposedly working for him. The applications engineer is, in such circumstances, unable to formulate a computer search which will satisfy the client's needs. If, by chance, he does arrive at the right combination of terms, he is unable to evaluate the output with any degree of relevancy because he isn't sure of the exact question being asked. The only answer to this problem we have found is intensive work on the part of the engineer to create the necessary atmosphere ;

of confidence. The client is repeatedly assured that no information concerning that client is divulged outside STRC; that the company is assigned a code number and all documents pertaining to the client bear that number, not the company name; that any references to the company in official reports will be cleared with the company prior to publication; and that no other company will be given the results of work done for that particular client. In many cases, this is sufficient and eventually a good working relationship is established. Sometimes the innate suspicion remains and the client fails to become a profitable user of STRC services.

An applications engineer often accompanies the director of marketing, especially when negotiations have reached the point of determining interest areas and subscription size. Mr. Kelly, with a working knowledge of a company's operations, will request the assistance of that STRC applications engineer whose background and experience are most closely allied with the company's major area of activity. This engineer meets with the company's representatives and helps them determine the combination of services and level of subscription which best suit their needs.

If no outside factors change conditions, the applications engineer, upon subscription, is then assigned that company as a client and remains its chief point of contact with STRC from that time on. He is responsible for servicing the account in all particulars, determining interest areas, devising retrospective search subjects and strategies, evaluating abstracts, and providing the client with selective dissemination from manual reviews. If an engineer is unable to continue with his assigned client, the applications engineer next most closely allied with the client is assigned.

It is our aim - and some progress is being made toward it - for the applications engineer to become an accepted member of the client's team. Not only will he provide the client with technical documents, but often his own industrial experience can be utilized to the extent of offering advice on application of technology, suggesting new regions to explore, different processes to try. In some instances, the STRC engineer could conduct parallel manual searches or try simple calculations on approaches to problems.

This should be highly beneficial to the smaller companies, whose professional staff may consist of one engineer and several technicians. Too often these clients are so busy putting out brush fires on the production front that they have neither time for, nor interest in, the technical information supplied by STRC.

Again, the client's confidence in the professional ability of the STRC engineer and that engineer's dedication to the client's interests is the keystone to the entire program.

There is, of course, no industry which utilizes technology from only one discipline, and industrial problems often cross three or more scientific boundaries. One client may need competence in metallurgy, chemical processing, and ceramics; another may be concerned with electronic design, fluid flow measurements, and textile processing.

The close-knit aspect of the STRC staff results in many informal shop-talk sessions in which client problems are reviewed and discussed. Engineers are often able to contribute suggested sources of material, advice, and expert opinion for another engineer's clients; many times their industrial experience in

similar situations will offer solutions. This set-up provides an opportunity for almost unlimited interplay between engineers and disciplines, and applications engineers are able to communicate with each other in depth and without restrictions to provide clients the maximum professional assistance.

For more difficult client problems, arrangements are made to secure the services of a consultant, a known specialist in the problem area, from one of the Triangle universities.

D. Services Available

Resources

STRC, in line with other RDC's, has two basic services to offer:

retrospective searches
current awareness (monthly updates)

These may be used separately or together, and in combination with the various files available at STRC can add up to several different types of subscription contracts. At the close of the current contract period, we were able to search:

	Number of Citations
NASA file (1962-1969)	367,271
DDC file	83,768
ITT file (Textile Technology Digest from the Institute of Textile Technology)	36,679
ERIC file (Educational Resources In- formation Center of H.E.W.)	21,260

	Number of Citations
Chemical Abstracts Condensates (from mid-1969)	2,000/month
Engineering Index (from 1968)	30,000

A fly-sheet setting out these resources is shown in Exhibit A-1.

Because of the wide variance in subscription sizes and combinations, we cannot frame an average subscription profile that would be realistic; it would entail adding oranges and squash. It is primarily the application engineer's responsibility to determine which service or combination of services will be of the most value to his client. His familiarity with each of the files enables him to predict with a fair amount of accuracy which will be most productive for the area of interest in question.

Although many citations are carried in both the NASA and DDC files, a recent study at STRC revealed that for retrieval purposes, the overlap should be ignored and that both collections should be searched whenever it is likely that the subject is well represented in both.

1. National Aeronautics and Space Administration (NASA File)

The NASA file, having approximately 70,000 new acquisitions per year, is science-oriented and strong in such areas as:

- electronics (radar, tracking, miniaturization)
- materials (alloys, coatings, heat transfer)
- aerodynamics
- environmental biomedicine (selection of man for the
job, keeping man alive in alien environment)
- mechanics
- space sciences

2. Department of Defense (DDC File)

STRC has found the DDC file to be an engineering or applications-oriented file, and that subjects in which it is particularly strong include:

- earth sciences (water resources, flood control,
water and air pollution)
- socio-technical areas
- earth-bound transportation
- food sciences
- clinical medicine (immunology, infectious diseases,
social diseases, personnel injury, deafness as
a problem)
- military sciences

This same file is weak*, however, in material sciences (Metals, plastics, reinforced plastics, special structures), physics, chemistry, and engineering mechanics.

3. Institute of Textile Technology (ITT File)

Articles abstracted in the Textile Technology Digest, which is published monthly by the Institute of Textile Technology Digest, are now on computer tape and available for retrospective searching from 1966 to the present. This file contains approximately 33,000 documents and has proven valuable to STRC's textile clients--the number-one industry in North Carolina and much of the South.

* As compared to the NASA file.

4. Engineering Index

Through the Aerospace Research Applications Center (ARAC), STRC has access to the Engineering Index CITE file, an applications-oriented file which cuts across most engineering disciplines. The file is in two categories, one on Electrical and Electronic Engineering and one on plastics. It dates from January 1968 and is very limited in number, totalling approximately 30,000 accessions at the present with 1400-1800 additions per month.

Neither documents nor abstracts on this file are supplied to clients; it is strictly "citation." However, STRC engineers predict that this will become one of the most valuable resources we have, pointing out that the material in it is less scientific, less technical, and is easier to apply than is the material from the NASA data bank. It is available for retrospective searching, custom-tailored interest areas, and standard interest profiles.

5. Chemical Abstracts Condensates

CA Condensates are prepared by the American Chemical Society and are available to STRC through an arrangement with the Knowledge Availability Systems Center (KASC). These tapes contain abstracts covering approximately 13,000 journals, plus extensive patent coverage, and are open for retrospective searching dating from mid-1969. They are admirably suited to custom-tailored interest profiles, and STRC engineers anticipate heavy usage by their many chemistry-oriented clients.

6. Educational Resources Information Center (ERIC File)

The STRC inverted file programs were used to create an information system for the Center for Occupational Education at NCSU. This collection is based on the computer tapes prepared by the Educational Resources Information Center (ERIC) of the U. S. Office of Health, Education and Welfare. The source of over 21,000 documents on education research is the journal of Research in Education covering the years from 1964 to June 1969.

Retrospective Searches

Retrospective searches review all the material available on a particular subject since the beginning of the NASA file in 1962. The Subject Authority List (SAL) series covers the years 1962-1967. In 1967, Thesaurus indexing was initiated, requiring different strategies from SAL, therefore a complete search will require that both series be covered. Figure 4 shows search strategy for both SAL and Thesaurus.

A search request may arrive at STRC in any of four ways--by letter, telephone, TWX, or as the result of a personal visit. Unless by telephone or visit, a personal contact is often necessary to clarify the search subject. The relevancy and productivity of the search depends on several factors: (1) key terms used; (2) search strategy prepared; (3) number of postings given per key term. The first two depend almost entirely on the applications engineer's thorough understanding of the client's search subject.

When the engineer is satisfied with his understanding of the problem, he writes the search strategy in the form of a Boolean

logic equation, and gives it to the technical assistance section.

GENERAL SEARCH STRATEGY

- A Kel-F
- B Teflon (Trademark)
- C Histories
- D Chemical Properties
- E Manufacturing

STRATEGY: $(A + B) \cdot (C + D + E)$

Figure 4

Clerks recheck the logic for errors, prepare a load sheet, and keypunch computer cards on the IBM Model 029 Key punch. A TWX search request and a prepared load sheet are shown in the Appendix Exhibits A-2 - A-4.

The search is now ready to go to the computer operator at TUCC, in the north wing of the STRC building. In a matter of minutes/seconds, the results are shown on a computer printout.

THE TERM NUMERICAL ANALYSIS WILL BE
THERE ARE 1365 HITS IN THIS UNION

THE RESULTS OF GROUP 2 FOLLOW
THERE ARE 1365 HITS IN GROUP 2

GROUP 2 WILL INTERSECT WITH GROUP 1 (OR THE P

63015970	63182320	64010762
64116829	64117313	64118234

Figure 5

As you will note, a printout is a string of accession numbers only, each number being eight digits long. In reading a printout, the "A" and "N" series are identified by the third digit in each series, 0 = A and 1 = N. (63015970 = A63-15970, and 64116829 = N64-16829.)

The printout and cards are then checked and recorded by the technical assistance section before being given back to the engineer who can determine the success of his strategy by checking the final hit list. Since he knows the approximate number of hits or citations to expect, a wide discrepancy points up an error in logic.

Clerks then pull abstracts for all citations in the final hit list and the abstracts are given to the engineer for evaluation. If the results are not satisfactory, the search will often be re-written and re-run.

The engineer sends the computer printout plus all the abstracts which he deems relevant to the reproduction section. Here the abstracts are Xeroxed and these, together with the printout, are bound into booklet form. One copy is retained for the master file and one is returned to the engineer for approval. The search results are then sent to the clerical staff to be logged out and forwarded to the client.

The flow chart on page 25 traces the action on a retrospective search. Each bibliography as well as all documents sent to a client is recorded in two separate records: (1) the company file which shows all service received by that client; and (2) the master log which shows all documents and bibliographies mailed by STRC.

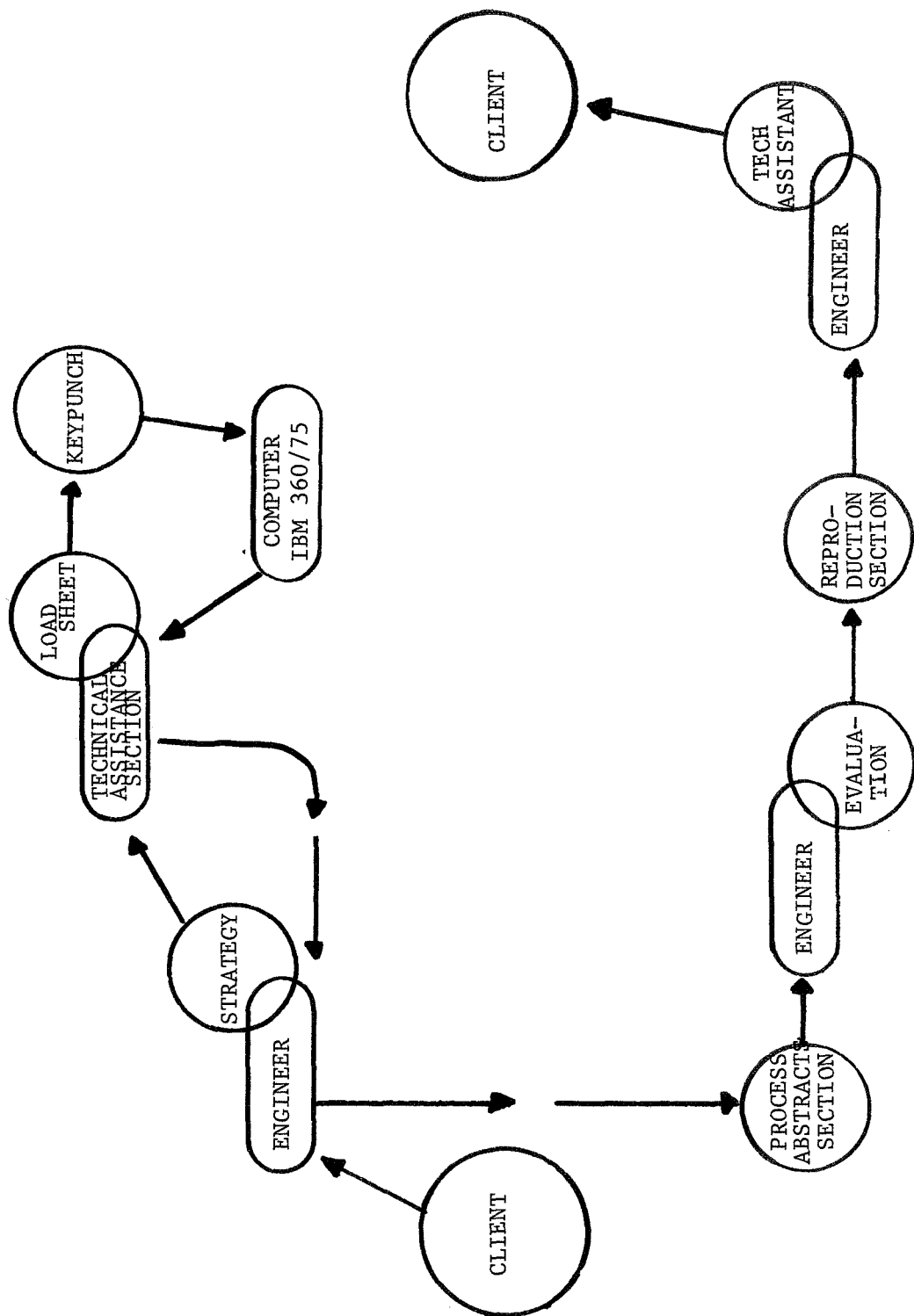


Figure 6
PRODUCTION CYCLE ON RETROSPECTIVE SEARCH

A work card (Exhibit A-5) follows a literature search through the entire procedure. This card enables STRC to determine how much time and money is required for each search, and has proven very valuable in setting up new pricing schedules.

Current Awareness Searches

The graph on the next page illustrates the ratio of retrospective searches to Current Awareness Searches (CAS) since the first offering of this service in October 1968.

Some STRC applications engineers feel that these searches are becoming more important to their clients than the stock-in-trade retrospective search for several reasons: (1) the NASA file becomes more voluminous every year, resulting in search results too large for industrial clients to review effectively; (2) technology advances at such a rapid pace that work reported six years ago is often no longer relevant; (3) CAS's insure that the client "knows what the competition is doing," enabling him to make budget recommendations or change the direction of his P&D accordingly.

Interest Areas (I.A.'s) apparently fall into two main categories:

- subjects dealing with improvement of present products or processes (corrosion of metals, deterioration of man-made fibers); and
- subjects which conceivably may lead to new products or entirely new areas of research

A third type of current awareness is encountered in the academic community, in which a professor may devote his entire life to one highly specialized field and his research in that

field will continue for many years. He will subscribe for an I.A. which will cover the entire field of his interest, but because of his highly specialized subject, the I.A. will be relatively narrow. From time to time, as he contracts to do specific research within that field, he will need detailed coverage on that particular aspect. Thanks to the CAS, he is current on the latest developments in that one aspect, as well as the rest of his subject. Unfortunately, the academic researcher is limited both by financial considerations and by his belief that, as an expert in that field, he is the source of most of the new developments and does not need to be kept abreast on what others are doing.

Many of the current awareness searches now being run for clients of STRC are the outgrowth of a retrospective search, and use the same search logic. Some CAS's are designed by the applications engineer primarily to enable the client to become familiar with the contents of the NASA file. These CAS's are usually quite broad in strategy. As the CAS's screen only some 7,000 citations as compared to over 500,000 for a retrospective search, the strategy can be much broader without overloading the engineer evaluating the search.

Naturally, search strategy varies from client to client and engineer to engineer. One applications engineer states that he uses from 10 to 12 related terms for each update and requests everything under those terms. He uses almost no intersections in his logic. On this basis, he receives about 50 percent relevancy. Two of his clients have requested all citations under the subjects selected and abstracts on these are forwarded without any review, even if completely irrelevant. Two updates are amplified by manual searching of the Textile Technology Digest for that period.

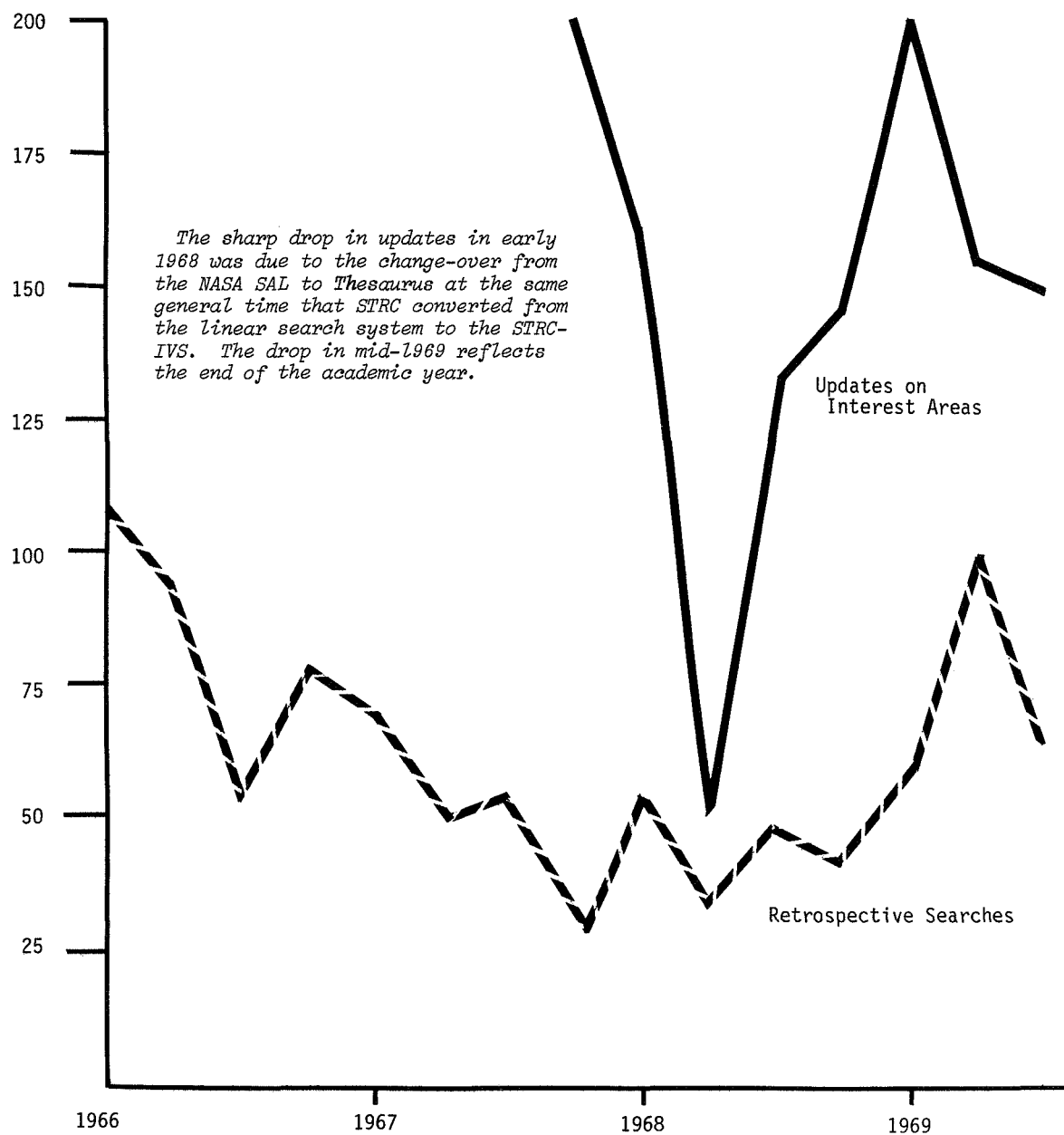


Figure 7
SERVICE TO INDUSTRIAL CLIENTS

Another engineer reports that he normally writes a very tight search, and screens every citation carefully.

After the search is written, the engineer is usually not involved in processing the monthly update. The clerk in the technical assistance section routinely pulls the load sheet and changes the numbers on the keypunched cards so that only the information added to the file since the last update is included. The search is run on the computer and a clerk pulls the abstracts from the computer printout. The abstracts are Xeroxed and sent to the client. To make sure that the strategy is giving the client the best possible search information, the engineer reviews the search quarterly and makes changes if necessary.

The question of "how current is current awareness" apparently does not bother STRC clients, although records show a lag of nearly two months between the time an item appears in IAA and the date it is brought to the attention of the client.

For example:

July 1 - 5	Item first appears in IAA
July 20	NASA tapes* are received at STRC
August 1	Tapes are loaded on disk packs and are operative
August 10	Updates are run on computer
August 20	Abstract cards are received from ARAC and given to A.E. for screening
September 1	Last of evaluated searches is forwarded to client

* Tapes are not distributed until four journal issues are loaded.

STAR citations appear on the 8th and 22nd of the month, and conceivably the update which pulled them could reach the client by the 21st or 22nd of the following month. However, this is the shortest time period possible under present procedures.

Although client librarians are aware of the time lag, so far none has complained. The supposition is that they are quite content to let STRC do the searching, even if the material is delivered four to eight weeks after publication.

Selective Dissemination

The term selective dissemination identifies articles, document or abstracts which the applications engineer feels could be of interest or value to his client, but which are not the result of a computer search. This material is usually culled by a manual review of monthly journals and magazines, but is sometimes derived from meetings, seminars, and symposia.

Often selective dissemination is used by STRC as a marketing tool, especially if the staff has an awareness, beyond just general knowledge, of the company's interests. An engineer will, in scanning the daily in-flux of material, recognize an article or topic which coincides with the interests of a potential client. He will forward this to a personal contact within the company and inquire if this is of any value or interest. The client's response will often be a clue as to a more precise area of interest and the applications engineer is then in a better position to determine if the NASA system does in fact support the potential client's needs.

Perhaps the greatest value of selective dissemination is the psychological factor--keeping the client aware of STRC's

continuing interest in his needs. Selective dissemination is a reminder of STRC resources and capabilities.

During the current contract period, 203 items of selective dissemination were forwarded to clients or prospective clients.

Documents

1. Sources

a. STRC --- When a client requests documents from STRC, the librarian determines the best source, the fastest if speed is necessary, the cheapest if speed is a secondary factor. The librarian checks the STRC "hard copy" library to see if the document is available and if it can be reproduced at a reasonable cost. If it consists of only a few pages, it will be reproduced on the Xerox Model 2400 electrostatic copier. When STRC has the document on microfiche and if it is less than 20 pages or if the client is willing to absorb the extra cost, it will be developed on the Recordak Model 1824 Reader/Printer.

If the client wishes a microfiche copy, the Atlantic Model 609 Micro-Folio is used to make duplicates of the microfiche.

b. Outside Sources --- When the document is not available at STRC, copies are ordered as follows:

"N" Documents (Since June 1968)*

ARAC (hard copy)

Clearinghouse (hard copy)

University of Microfilms (Thesis)

Source of report

* From January 1966 through May 1968 the main source for obtaining "N" documents was from NASA's STIF. When this source was discontinued, the above sources were substituted.

"A" Documents

D. H. Hill Library, NCSU

AIAA - New York

Source of report

The most legible copies are provided by D. H. Hill Library and University of Microfilms; the others are usually only of fair quality.

2. Categories

In analyzing the documents forwarded (by request) to clients, certain categories show up as in much greater demand than others. In descending order, the ten most frequently used categories for the current report period have been:

Category		Documents
<u>Number</u>	<u>Subject</u>	<u>Forwarded</u>
18	Materials, Non-metallic	530
17	Materials, Metallic	324
15	Machine Elements and Processes	263
04	Biosciences	245
26	Physics, Solid-State	234
05	Biotechnology	232
14	Instrumentation and Photography	199
07	Communications	187
32	Structural Mechanics	184
06	Chemistry	176

Figure 8

The heavy usage in Biosciences (04) and Biotechnology (05) reflect primarily the continued servicing of the Biomedical Applications Team (BATEAM) at the Research Triangle Institute.

BATEAM, operating under NASA contract, studies problems referred to it by a wide medical clientele.

Categories 25 (Physics, Plasma) and 30 (Space Sciences) reflect document orders received almost entirely as the result of one successful retrospective search run for a faculty researcher at an out-of-state university. (It has been the experience at STRC that faculty researchers order much larger quantities of documents than any other single group. The theory which best seems to explain this phenomena is that faculty researchers have both more time to read than do industrialists, and more associates in related, though not identical fields, who are interested in those citations not needed by the originator of the search. Thus, instead of the handful of pertinent documents ordered by an industrial subscriber we send large quantities of categorized documents which are generously distributed among fellow academicians.)

The quarterly demand for documents in these categories is relatively limited; industrial clients are not as concerned with pure theory in the sciences as they are with practical applications of technology.

The following graph illustrates the effect on category statistics of one professor's retrospective search on Plasma-Electron Beam Interaction and ensuing document order.

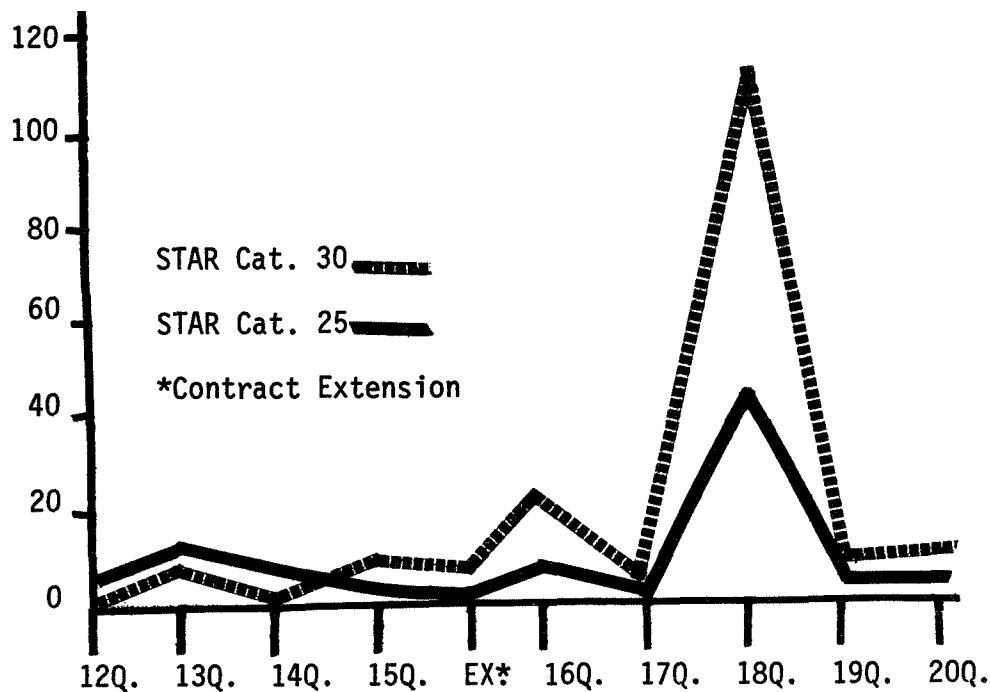


Figure 9 - Use of STAR Categories 25 and 30

There does not seem to be any particular pattern in the number of documents sent out per contract quarter, other than in the categories as previously noted. Usually, document requests follow search runs by one to several weeks, and the period in which those documents are mailed out to the client could be days or weeks later. Thus, the time lag between search request and document delivery on an annual basis as shown.

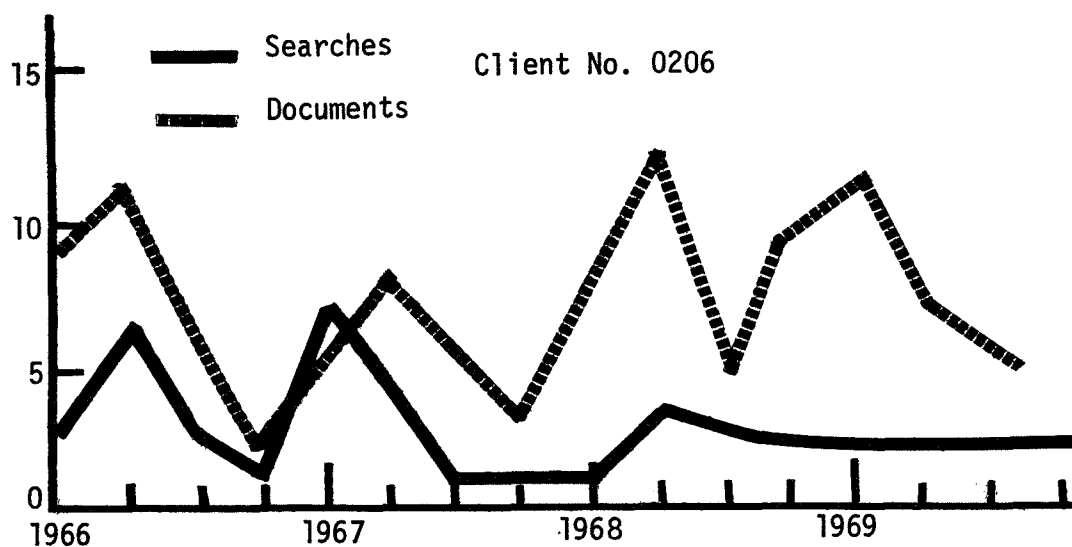
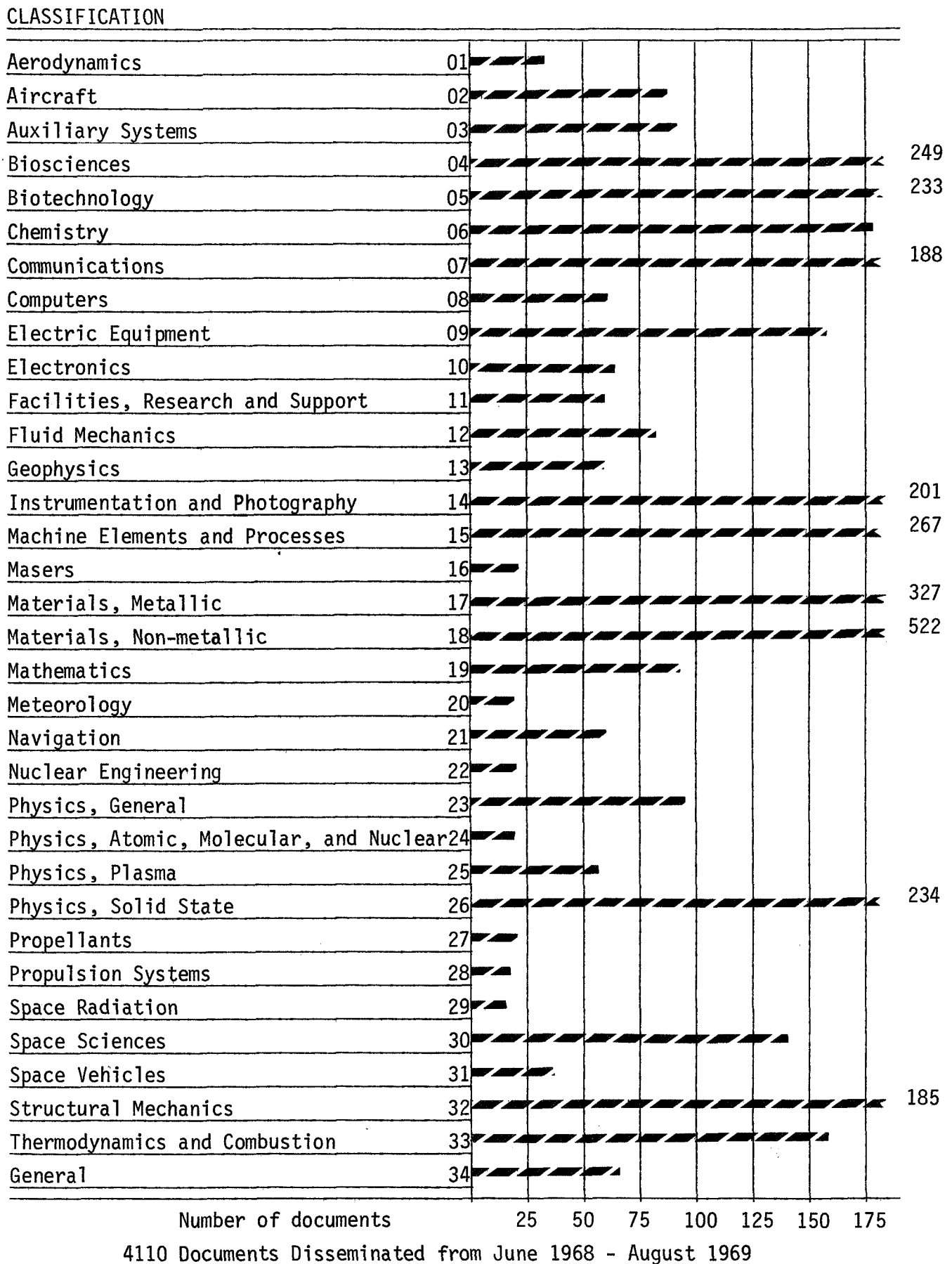


Figure 10 - Time Lag between Searches and Documents

FIGURE 11
CLASSIFICATION OF DOCUMENTS DISSEMINATED



Literature Searches for Other RDC's

Beginning in August 1968, the STRC-IVS was used to run retrospective searches for other RDC's. These are almost entirely machine runs, and do not involve the engineering or professional staff of STRC to any great extent.

Each Center writes its own search logic which it then transmits to STRC via TWX. This message is taken by a clerk in the processing section and checked for spelling and other inaccuracies. A clerk then follows the same procedures as for a STRC retrospective search (loadsheet, keypunching, transmittal to IBM 360/75 computer) with one exception: a routing card is added to the deck which instructs the computer to transmit the printout to our TTY, printing typed copy and cutting a tape at the same time. The tape is immediately transferred to the TWX and the results sent to the requesting Center. A regular printout is mailed to insure accuracy. (See flow chart, Figure 12, on the following page.)

The only difficulty with this system at the present time is the unfamiliarity of other RDC engineers with the STRC-IVS. This has sometimes led to incorrect or unwieldy search logic, and we must then contact the sending RDC for clarification. It has been suggested that Mrs. Williamson, systems analyst, visit each requesting RDC to conduct a workshop on setting up search strategies for this system. This should help reduce costs for the requesting RDC and relieve the workload on STRC staff members at the same time.

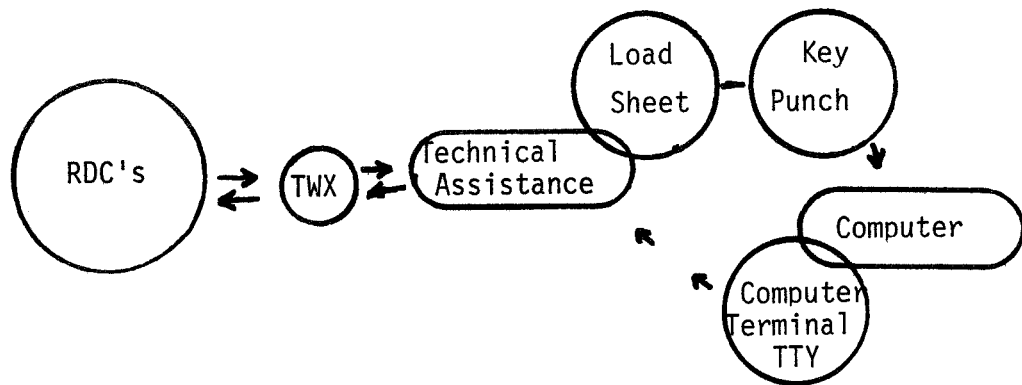


Figure 12 - Production Cycle on Searches for other RDC's.

State Technical Services Searches

Retrospective search bibliographies on 36 topics of general interest were prepared as part of STRC's participation in the N. C. State Technical Services program. As of August 31, 1969, we had distributed 180 copies of these searches in response to requests from industry in North Carolina and neighboring states. For a more detailed discussion of this project, see Section VI.

Graduate Student Program

STRC's Graduate Student Program reached 179 advanced degree candidates in 17 universities during academic 1969-70. Approximately 90 per cent of the returned evaluation questionnaires, and a complete report on the project was submitted under the title "Technical Report No. 108: Literature Searches for Theses by Computer; Second Year of the Program."

This special project is discussed more fully in Section VI.

IV. MARKETING

A. Mission

The availability to industry of information on many of the technical and scientific advances generated by the space program is, unfortunately, not generally well-known outside those companies which have had contracts with the federal government. The first task in a technology utilization program, therefore, is to inform industry of the what and how -- what is available and how to tap the source. The prime mission of the STRC marketing division is to induce industry to take full advantage of this huge federally-subsidized program. A second goal is to make STRC self-supporting through recruitment of fee-paying clients.

B. Orientation

As shown in the organizational chart on page 3, the marketing section is headed by the assistant director for marketing (L. M. Kelly), under the supervision of the director.

C. Personnel

On paper, Mr. Kelly, with clerical assistance, comprises the marketing division; in actuality almost the entire staff is engaged in this effort. The director contributes through appearances before civic and professional groups, the engineers are involved through their daily contacts and when accompanying the marketing director on sales trips. The technical editor is charged with preparation of various marketing tools such as brochures, flyers, newsletter, and slides, and works closely with both the marketing and engineering staffs.

Beginning with the new academic year for 1969-70, Miss Becky Walker, coordinator of the graduate student program in previous years, will join the marketing staff as an aide to Mr. Kelly. Her initial responsibility will be to contact faculty, graduate students and librarians in each of the 23 universities participating in the GSP. For a more detailed discussion of this program, see Section VI.

Clerical and secretarial chores are divided among the three secretaries on the STRC staff. The bulk of the form letters (not to be confused with mass mailings) are typed on the IBM Magnetic Tape Selectric Typewriter (MT/ST) which produces error-free originals automatically at the rate of 185 words per minute. Personal or individual letters, trip reports, filing and record-keeping are divided between the other two secretaries.

D. Methods

Mass Mailings

A number of methods have been tried in the continuing effort to inform and recruit industry into the technology utilization program. The most obvious starting point was the direct mail campaign.

Early in 1966, a mass mailing by states was initiated and eventually nearly 600 companies and/or individuals received the first of two form letters. This was an introductory letter, addressed to the company president or director of research; enclosed was a return-address postal card to be checked for the type of information or service desired. From this mass mailing, which included the most promising potential users of STRC in Virginia, North Carolina, South Carolina, Georgia, and Florida,

six cards were returned. STRC engineers made at least one visit to each company replying, but no clients were obtained. There were no replies to the follow-up letters, which were discontinued about half-way through the original mailing list.

A similar mailing was prepared and sent out during this contract period in reply to the Kiplinger Washington Letter and Changing Times inquiries forwarded by NASA to STRC. As in the earlier attempt, these failed to produce results commensurate with the effort and expense entailed. Although no formal records were maintained, we can find little indication that a mass mail-out, even if followed by a second mailing, has had much effect on the marketing effort.

Seminars, workshops, conferences, and general presentations before large groups have been equally unrewarding in attracting subscribers. The time and effort involved in putting these on has proven prohibitive in terms of the number of clients recruited by them.

Referrals and Inquiries

Referrals and inquiries merit and get immediate attention because they represent prime marketing prospects--the need and interest are both (presumably) already present. Unfortunately, STRC's experience has not been very good with these potential clients -- in fact, a review of action taken on all referrals and inquiries in the past 18 months reveals that not one single client has been added to the STRC roster through cultivation of this group.

In light of their apparent potentiality, the question immediately arises as to why the zero batting average. We studied all the correspondence and records available and made the following determinations:

1. NASA Referrals

The largest single group of inquiries has come through NASA in response to articles on the NASA Technology Utilization Program appearing in The Kiplinger Washington Letter and Changing Times. STRC sent out several hundred letters as follow-ups to these inquiries, but only two companies are deemed potential clients and neither of these has subscribed. The chief characteristics of the authors indicate the problem:

a. With very few exceptions there was no identification of the writer or affiliation with a company given. Most of the inquiries were obviously from students or women responding to a big give-away program of free information. Only 17 of 58 letters were typed and semi-professional.

b. The very broad areas of interest mentioned ("space science," "everything on the NASA program") indicate that the writers have no comprehension of the TU program, and likely do not have the capability to use the material supplied.

c. In the few instances where company affiliation was given, the company was usually an RDC client, either at STRC or elsewhere, and the writer not aware of it.

The next question that arises is why was this group of non-users attracted instead of the potential users everyone would like to attract. Part of the answer probably lies in the popular-appeal slant given in these articles, the "big give-away program" feeling mentioned earlier. Another factor is that the role of the RDC as the expeditor of material from NASA to the potential user is underplayed. This is also true in many of the NASA publications, in which the only reference to RDC's is a final paragraph stating that "further information is available through the following Regional Dissemination Centers..."

STRC staff members feel that every RDC would be aided by a concerted effort on the part of NASA to publicize the status of the RDC's in the NASA Program. It would also help in clarifying the difference between the TU officer at Langley or Huntsville, for instance, and the full operating program of an RDC. Too often the audience at a sales presentation is unaware of the RDC program prior to the presentation, and then, unless the speaker is very skillful, completely confused as to the distinction between the two TU's.

2. Referrals from Other RDC's

Referrals forwarded from other RDC's are usually shake-outs of the Kiplinger or Changing Times letters which fall within the STRC geographical area. The same factors as noted above apply.

3. University Interest

STRC does receive referrals and inquiries from the universities and the Research Triangle Institute which obviously represent sincere interest from qualified potential users of the

STRC resources. Many of these are outgrowths, in one form or another, of the Graduate Student Program, and are given every attention. There is increasing recognition that one of the most effective ways of advertising the TU program is through the advanced degree candidates, many of whom soon enter the industrial market we are trying to reach. Those who remain in teaching capacities are able to pass the good word along to other faculty members, succeeding graduate students, and industries they may serve as consultants.

The Graduate Student Program unfortunately also reveals that the major deficiency in the system is the lack of breadth in the NASA file. Selling to the academic community has two other drawbacks: (1) it takes as long to sell one search to one professor as to sell several to industry; (2) the digestive period is slow, so time between searches is long.

4. Newsletter Response

The inquiries received in response to an article in TECH TOPICS have also come from fairly well qualified sources, but again have been unprofitable as far as subscriptions are concerned. From the four issues of the newsletter already published, we have received 29 inquiries on the NASA or related files, and 160 requests for the STS searches described in Section VI. Each of the 29 inquiries received a carefully detailed reply and a follow-up visit whenever feasible. Again, many of the inquiries came from personnel in companies which were already STRC clients.

5. State Agency Referrals

STRC also receives support and referrals from the Commerce and Industry Division of the Department of Conservation and Development.

Personal Presentations

The most successful method of selling the TU program remains the personal presentation, preferably to one or more members of management accompanied by as many representatives of the company's engineering, research, and information divisions as can be present. Such a presentation is normally set up days or weeks in advance and is usually preceded by several letters and telephone calls which establish the company as a potential client, identify (if possible) general areas of interest, and lay the groundwork for negotiations of a subscription. Although every sales presentation is a one-of-a-kind performance, a general format has evolved which has proven reasonably concise and effective. Following introductions, the program usually consists of:

1. Semi-formal talk* by L. M. Kelly or other STRC staff member along the following lines:

- a. Explanation of NASA file; (1) purpose of RDC program, (2) our affiliation with NASA, (3) scope of collection;

- b. Discussion of the data bank most closely allied with interests of that particular company (DDC, ITT, etc.);

* Illustrated with color slides when feasible. At the present time, new slides are being prepared to keep current with the text. In 1967 we prepared a coordinated filmstrip and sound track which was presented by means of a LaBelle Courier, a desk-model machine with enclosed screen and speaker resembling a portable TV set. Although well-received initially, the material soon became outdated and we experienced technical difficulties in having the filmstrip redone.

c. Explanation of how company can take advantage of RDC service.

2. Question-and-answer period during which STRC staff member tries to get members of the audience to identify specific areas of interest in order to relate STRC resources to the needs of the company. During this period, Mr. Kelly distributes literature such as STRC flyers, copies of the TECH TOPICS newsletter, and search request forms if interest is indicated. Members of the audience may also scan sample searches in the general area of the company's interests.

3. Closing comments and an attempt to get a commitment as to the next action to be taken; i.e., company will sign subscription contract, company will notify STRC as to decision, etc.

A second visit is sometimes necessary before a company subscribes and it is on this visit that the applications engineer accompanies Mr. Kelly. (See Section III on the relationship between applications engineers and client beginning at this point.)

Marketing does not close out with a signed subscription. Mr. Kelly reviews client activity from time to time throughout the subscription period, and begins negotiations for subscription renewal one or more months before the anniversary date.

Civic and Professional Meetings

1. Group Presentations

Although we welcome any opportunity to explain STRC services and resources to civic and other non-professional groups, these occasions have occurred more infrequently than we would like, and

as far as we can determine, no client referrals or inquiries have come to STRC through such speeches and presentations. This may be for any one of several reasons: (1) STRC is still fairly new -- created in 1963 but actually in full operation only since late 1965 -- and still highly experimental in nature. It has not yet had time to acquire stature outside a restricted community. Neither is it essential to all citizens as is the Revenue Division or Public Health Department. (2) STRC is also quite small, as governmental agencies go, and therefore does not command attention as would a large organization. (3) The physical location of STRC, although ideal from the standpoint of professional contacts and working facilities, isolates it from the mainstream of business. (4) The technical nature of computerized information retrieval and the relatively new concept of technology dissemination and utilization are beyond the interest level and outside the reference frame of the average civic group. The twenty to thirty minutes usually allotted an after-luncheon or dinner speaker are not sufficient to explain the program in enough depth to be meaningful.

2. Professional Meetings

Obviously, it is both easier and more profitable to present the STRC program to professional groups who have the background to understand and the capability to utilize our services. Mr. Chenery and the other staff members have accepted invitations to speak at a number of these meetings, including the local section of the American Chemical Society and classes in Library Science at the University of North Carolina, Department of Mechanical Engineering at Auburn University, Department of Education at North Carolina State University, and the American Textile Manufacturer's Institute.

E. Tools

Because of the size of the STRC regional area (map pg. 53), travel looms as the largest single time-consumer in the marketing area. The State of North Carolina provides a car and per diem expenses, which has proven the best (although not ideal) solution to the problem of contacting potential clients. Planes and trains leave the traveler without transportation from the terminal to the industrial site, which is often located several miles out from the city. Rental cars are sometimes used, but the N. C. State Budget Division prefers the use of state vehicles. This, of course, is fatiguing as well as time consuming and restricts the amount of territory Mr. Kelly can cover in a given period.

Obviously, some other methods of contact must be utilized, and for this purpose we have devised marketing aids:

1. Form Letter

An introductory letter addressed to a member of management within a potential client company. These letters differ from a "mass-mailing" in that each letter is an original, often slanted toward a particular industry, and is directed to an individual whose name and title have been previously secured. These letters are typed on the MT/ST, and a 3' x 5' card records all the pertinent information needed for later review and follow-up.

2. STRC Flyer

A 3-fold, 3-color leaflet which describes very briefly our services, resources, orientation and mission. This flyer is enclosed with the introductory letter. It was designed originally

as an interim-type material to replace an outdated formal brochure; we hope to have the brochure updated and reprinted within the next few months. The flyer will also be updated and retained for special purposes.

3. Fact Sheet

One-page printed forms which give more detailed information about a specific resource (TECH BRIEF, ITT file) than does the flyer. These are normally sent in reply to inquiries.

4. Newsletter

In an attempt to provide much wider exposure for the Center and explain its mission to the general public, a newsletter to be published four times a year was initiated in November of 1968. TECH TOPICS covers items of interest on both the Board and Center, and we strive to write it in an informative but interesting style, easily read by non-professionals.

We use the newsletter to announce new information resources, acquaint readers with the professional qualifications of Board and staff members, provide background data on items announced in TECH BRIEFS, and interest potential users in the applications of aerospace technology. A coupon on the back page invites readers to request additional and detailed information on any of several areas of interest, such as the TU program, the ITT file, TECH BRIEFS, and the Board's research grants program. Each issue of TECH TOPICS has elicited from five to twenty inquiries, primarily on the ITT file or the TU program. Within the first two weeks after publication, the July 1969 issue drew requests from 14 sources for a total of 55 general searches prepared in cooperation with the North

Carolina State Technical Services Program. (See Section VI)

We have filed an application with the U. S. Patent Office to register the name and logogram, and have secured a second class mailing permit from the U. S. Post Office. The carefully-compiled mailing list now totals approximately 2500 names, the bulk of whom fall into one of four categories: (1) clients and prospective clients; (2) university faculty and graduate students; (3) selected state government personnel, including members of the North Carolina General Assembly; and (4) North Carolina industrial development groups, such as Chambers of Commerce. TECH TOPICS is also mailed to every library in North Carolina, public, technical, and academic.

The mailing list is updated and corrected prior to each mailing, and new names are added. We try to secure the names and titles of individuals within companies or organizations, and with few exceptions do not address a label merely to the company or a title within that company.

All writing, editing, and most of the photography is provided by STRC staff members. Under the guidance of the North Carolina Purchase and Contract Division, we entered into a one-year, extendable contract with a printing firm in Raleigh, which assists in layout and format. The addresses are printed by TUCC's IBM 360 computer, sorted by zip codes; STRC staff members prepare the newsletters for mailing.

F. Client Composition

On the basis of the recently completed marketing survey and a consensus of opinion among the engineering and marketing staff,

STRC has prepared a profile of companies capable of utilizing our services. It is considered desirable that clients:

1. have a competent staff with time and ability to complete projects using technical information;
2. are in a rapidly changing technical area, as opposed to a fairly static industry without a precedent of competitive innovation;
3. are financially solvent, so that they can support research and are capable of putting into effect the recommendations of their research staff;
4. have a progressive management, willing to implement new ideas; and
5. have a history of seeking and using information from a variety of sources, whether to keep abreast of developments in their field or as background for research.

The following sections, with accompanying charts and tables, indicate that a majority of STRC industrial clients are indeed large enough to support sophisticated research. One of the largest client categories is non-industrial -- university faculty members doing government research, private research organizations, and private individuals engaged in research. Although the original marketing effort was directed toward smaller, less sophisticated companies, current STRC clients more closely approximate the potential client profile. That is, all of our present clients possess at least one of the above attributes, and future marketing efforts will be directed toward companies which meet one or more

of the above standards.

Each quarterly report has analyzed client composition in terms of SIC code, size (number of employees) and type of business (manufacturing, research or academic). The tables, graphs and charts on the following pages present the growth or changes in client composition for the period January 1, 1966, to August 1, 1969.

Geographical Extent

The four maps in Figures 13 a-d trace the expanding of STRC's geographical territory from the boundaries of the State of North Carolina to its present area which includes 10 Southeastern states: Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, eastern Tennessee, and West Virginia. Since January 1966, at which time STRC inaugurated its fee-paying policies, the number of clients serviced outside North Carolina has risen from 8 to 28.

Much of this expansion is traceable to the Graduate Student Program (Section VI). Through this project, valuable contacts have been made with faculty members engaged in government and academic research including many who also serve as consultants to neighboring industry. The marketing study made by STRC in February 1969 indicates that intensification of service to states other than North Carolina will most likely continue to be through the universities and graduate students previously served. Potential clients in that area have been and will continue to be contacted; however, less than 1% of the companies examined in the marketing study are considered by STRC staff members to be potential STRC clients.

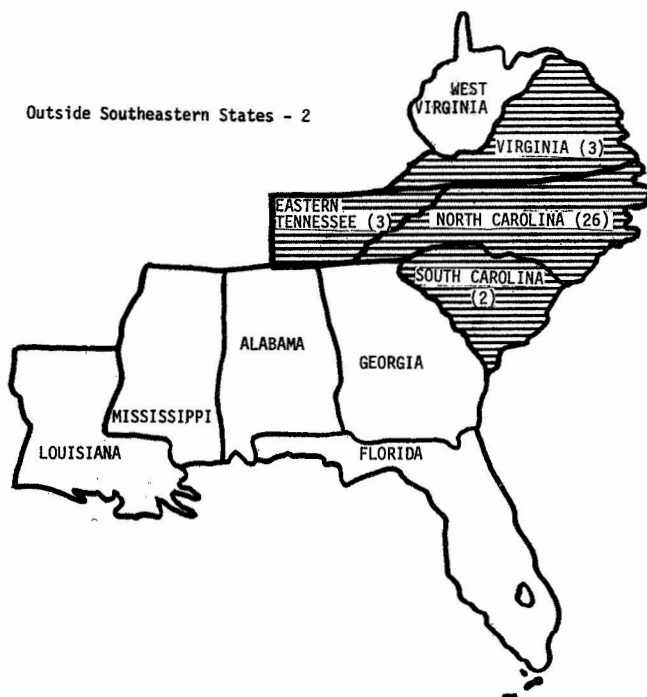


Figure 13a - 1966

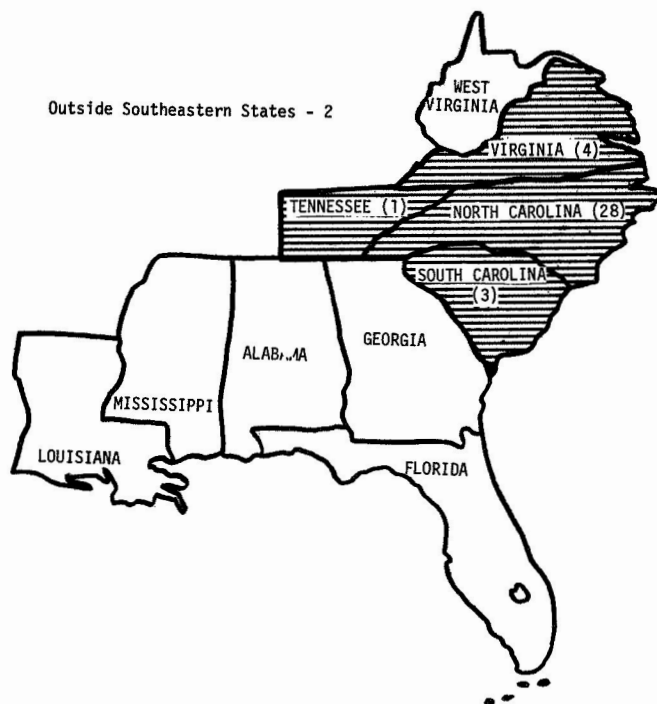


Figure 13b - 1967

STRC CLIENTS BY GEOGRAPHICAL LOCATION

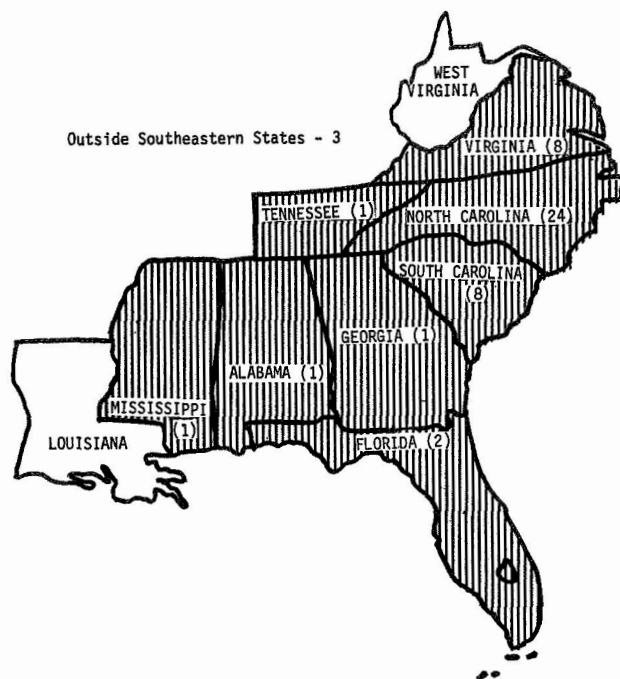


Figure 13c - 1968

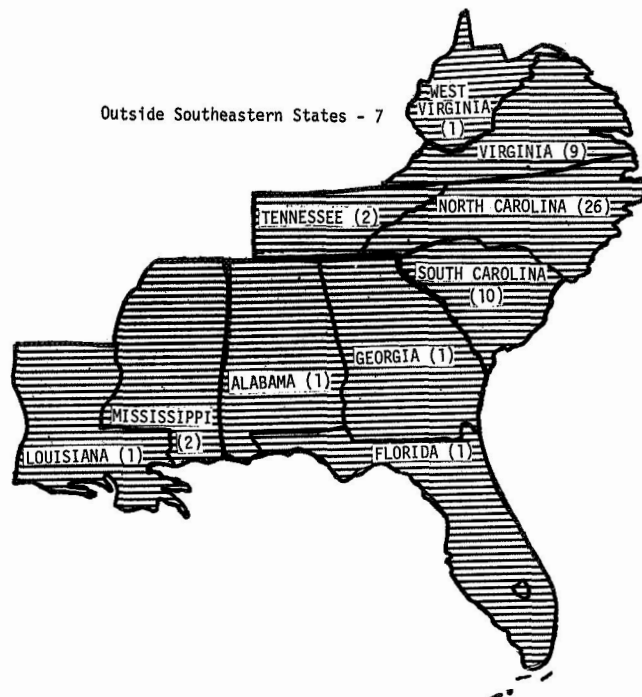


Figure 13d - 1969

STRC CLIENTS BY GEOGRAPHICAL LOCATION

SIC Codes

Figure 14 shows the proportion of STRC subscriptions derived from each SIC category. The strong growth in such industries as chemicals, electrical machinery, and primary metals is strikingly shown. Textiles, a leading industry in the South, accounts for little more than non-electrical machinery.

Non-industrial clients contribute a large share of STRC income as shown by the bar marked NIC. This includes university faculty members doing governmental research, private research organizations such as the Research Triangle Institute, and private individuals such as inventors or engineers. These are usually demand clients.

Company Size

Figure 15 is a breakdown of STRC manufacturing clients by the number of employees in the total company. Although STRC's initial program was aimed at the smaller, less sophisticated companies, the marketing study conducted in the fall of 1968 indicated that the preponderance of STRC clients is in the large, highly-sophisticated classifications. Note that over 84% of all STRC clients have more than 100 employees, 31.5% more than 1,000, and 15.75% more than 2,500.

Annual Subscriptions and Renewals; Demand Clients

The chart on annual subscriptions and renewals (Figures 16 and 17) shows a steady increase in the number of STRC clients renewing subscription contracts for each succeeding year. The decline in the number of new clients gained each year reflects

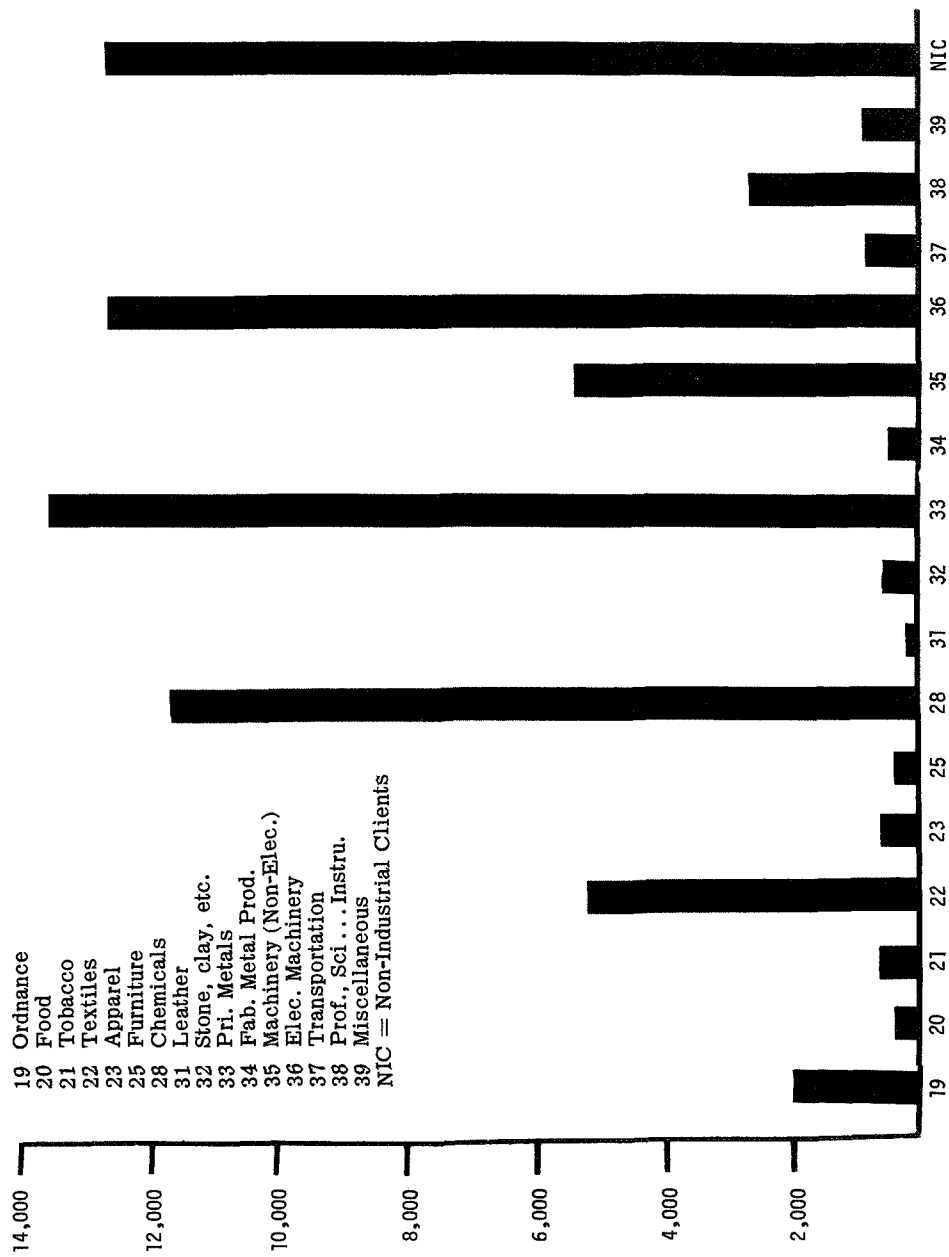


Figure 14

CLIENT RECEIPTS BY SIC CODE
January 1966 - August 1969

STRC MANUFACTURING CLIENTS BY COMPANY SIZE*

NUMBER OF EMPLOYEES	1966	1967	1968	1969
1 - 25	6	4	2	4
26 - 50	2	0	1	0
51 - 100	1	1	1	2
101 - 250	7	4	8	9
251 - 500	3	5	2	5
501 - 1000	9	9	7	6
1001 - 1500	2	2	4	4
1501 - 2500	1	1	1	2
2501 - 3500	2	3	3	3
3501 - over	0	1	2	3
TOTALS	33	30	31	38**

* Does not include demand clients or drop outs.

** Clients as of August 31, 1969

Figure 15

STRC RDC MEMBERSHIP January 1, 1966 - August 31, 1969

TYPE	1966	1967	1968	1969
New	33	20	13	9
Renewal	0	10	18	20
Demand Clients	3	8	18	24
Drop Outs	0	24	12	4
In Process	0	0	0	9
TOTALS	36	38	49	62

Figure 16

STRC ANNUAL SUBSCRIPTIONS AND RENEWALS
1966 - 1969

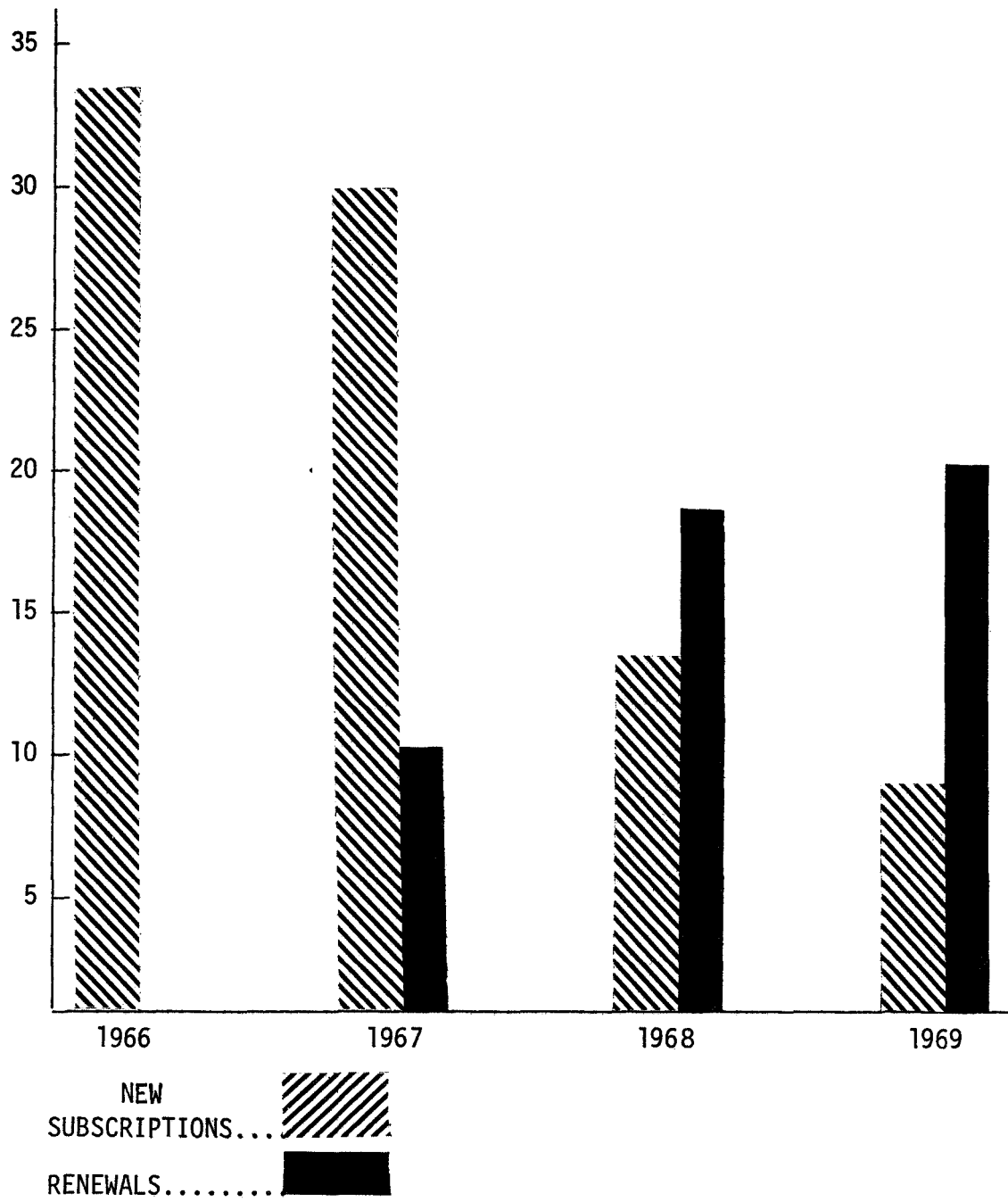


Figure 17

in part the pervasion of the potential market by STRC. It also reflects a reduction in federal spending, abrogation of federal contracts, and possibly a tendency on the part of industry to restrict R & D commitments during the current economic period.

The continued rise in the total number of clients subscribing for a second, third or fourth year, however, is a valid argument that the dissemination program is considered valuable by an increasingly large percentage of STRC clients.

STRC entered into the present NASA contract with a total of 31 annual subscribers and 12 demand users; at the close of this contract period STRC is serving 38 annual subscribers and 28 demand clients, for a total of 67. Twenty-two of the demand clients have been served for the first time since the beginning of the contract period; 14 of the annual subscribers have been added during the same period.

We continue to have trouble defining the terms used in conjunction with the subscription/attrition reports. If a client subscribes following an extended gap in service, does he become a new client or a renewal? If he changes from an annual subscription basis to that of "on demand," for what period of time between demands is he considered still an active client? The problem of definitions is responsible for some of the inconsistencies in our statistics.

G. Fee Schedule

From January 1966 until January 1969, STRC's fee schedule was flexible but fairly simple -- so much per retrospective search and so much per interest area, or a combination of the two at a

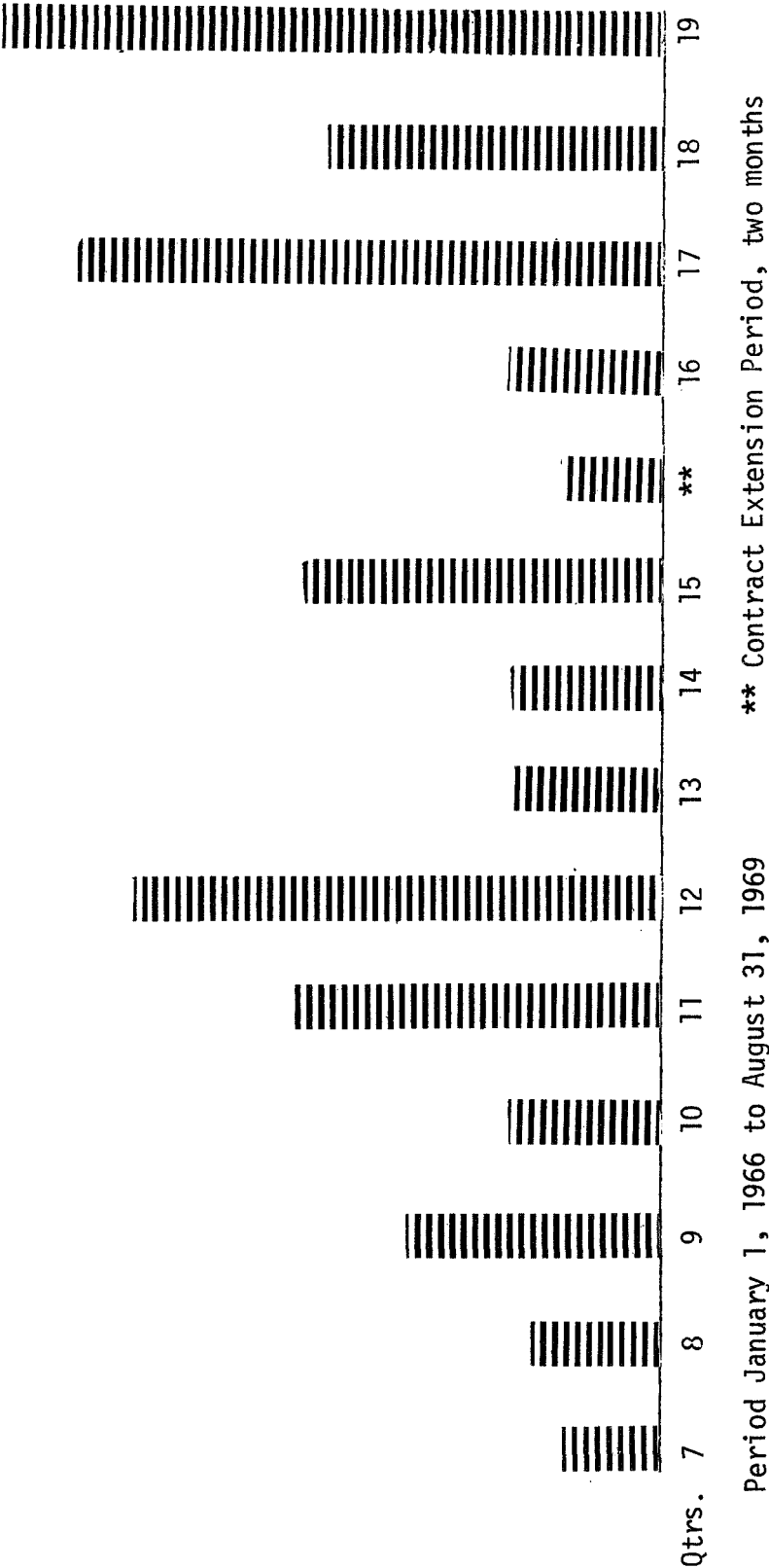
slight discount. Theoretically, the subscription fee covered actual out-of-pocket expenses such as computer time and reproduction costs, but no overhead expenses. All documents requested by clients as a result of a computer search were included as part of the overall subscription. This policy was based on the belief that requiring users to pay an additional charge for the documents might discourage them from making effective use of a search bibliography.

Under Article I-D of Contract NSR 34-007-006, STRC was required to perform a detailed study of its costs of providing services to subscribers. This was undertaken in 1968 in three parts. Part I entailed analyzing cost records which had been maintained at STRC up until that time; Part II involved the adoption of a job order system for all search services and the maintenance of these records over a period of time to insure that no cost factor had been overlooked or incorrectly determined. Computer programs were then prepared to summarize and analyze all the cost data from all records maintained at STRC (Part III).

Our studies showed a wide variation in the numbers of documents requested per search and we concluded that some subscribers were thereby supporting the costs of providing documents to other clients. Prior to initiating a new fee schedule, STRC staff members queried a number of clients on their reaction to separate payment for document copies; the majority indicated that, contrary to our belief, it would not appreciably change their use of our services.

Based on the cost studies performed, a new fee schedule was put into effect in January 1969. As contracts expired, renewals were negotiated on the basis of the new schedule, as were all new

Figure 18
TOTAL BILLINGS LISTED BY QUARTERS



client contracts. This resulted in some clients being served under the old scale, some under the new, and, where interest areas were added at a date subsequent to the initial subscription, both fee schedules would be in effect for the same client. At the close of the subject contract period, all but 13 clients had been converted to the new fee schedule. (Exhibit A-6)

The most drastic difference between the two fee schedules is in the area of documentation. Under the new system, all documents resulting from a search bibliography are priced separately. The cost to the client is based on the cost to STRC of acquiring the document, plus a small handling charge. Depending on length of document and source from which obtained, costs can vary greatly.

It is the consensus at STRC that the new fee schedule has not drastically affected renewals, client usage, or the acquisition of new clients. It has, however, resulted in a more equitable distribution of costs and reimbursements.

To add another dimension to our evaluation of services rendered, we viewed total operations in the light of monthly billings for accounts receivable. All chargeable RDC operations were considered, and included annual subscriptions, renewals, on-demand services, document orders, computer runs for other RDC's, the Graduate Student Program (GSP), and the searches prepared for the North Carolina State Technical Services (STS) Program.

Figure 18 presents these composite accounts by quarters, beginning with the initiation of the first fee schedule in January 1966. The current contract period begins with the 16th Quarter in June 1968.

We analyzed the wide variations in total billings per quarter, and confirmed that our peripheral activities such as the Graduate Student Program and STS searches had added substantially to our base income. The somewhat seasonal impact of the GSP is apparent in the 15th and 17th quarters, and the value of the STS searches is evident in the 20th quarter. It should be pointed out, however, that one billing for STS searches was made during this period for work accomplished over several months.

The important factor as far as STRC is concerned, however, is the general upward trend in total accounts receivable since the beginning of the current contract, and the importance of our peripheral programs.

V. COMPUTER ACTIVITIES

A. Information Retrieval

In a continuing effort to reduce computer search costs and time, STRC has expanded its information retrieval section. Headed by a part-time consultant, the full-time staff now consists of a systems analyst, a programmer, a technical assistant, and a combination keypunch/TWX operator. This is an increase of two people during the period of this report.

The computer section is headed by Dennis M. Phillips, instructor and doctoral candidate in aerospace engineering at N. C. State University. He first joined the STRC staff in June 1966 as a part-time consultant. Since that time he has planned and implemented installation of the NASA Linear Search System using the IBM 1410 computer, and directed the design and implementation

of STRC's inverted search system using the IBM S 360/Model 75 computer.

Mrs. Mary Ann Williamson, graduate of Westhampton College with graduate studies in computer science at the University of North Carolina, has worked closely with Mr. Phillips in designing and implementing the STRC-IVS and in formulating programs for processing other files or data banks, such as the DDC and ITT files. Formerly classified as a programmer, Mrs. Williamson has been promoted to systems analyst and supervises the remainder of the computer operations staff.

B. STRC Inverted Search System

At the beginning of the report period, the inverted search system developed at STRC was in use for all retrospective searching. The processing of current awareness interest profiles was transferred in August 1968 from the NASA linear search system to the inverted search system (STRC-IVS).

The designation STRC-IVS covers a family of computer programs for file creation, maintenance and searching, coded for operation on IBM system/360 computers with direct access storage and operating under control of OS/360. With this system we are able to create and process files from either punched card or magnetic tape input. We operate in the normal batch processing job stream of an IBM S/360 Model 75 owned by Triangle Universities Computation Center (TUCC). Some searching of small files is done in real-time using the Conversational Programming System supported on that machine. Experimental runs have proven the capability of operating these programs on an IBM S/360 Model 40 with 256K storage.

The basic search routine is written in Fortran IV and uses 360 assembler language subroutines to facilitate input-output processing. The various inverted files are created using the IBM-supported Indexed Sequential Access Method (ISAM). The use of ISAM allows us to retrieve the accession numbers under any one index term by going directly to a specific file location, rather than by searching through a file for the term. All files are loaded on IBM 2316 disc packs which are mounted on a 2314 Direct Access Storage Facility upon request. Program flexibility permits the use of other direct access storage devices which may be supported under OS/360.

C. Inverted vs Linear Searches

The computer search system designer's choice between a linear and inverted file structure is based on several considerations. With a linear file, where document records are arranged in chronological order by increasing accession numbers, a subject search requires processing the entire file unless the search is to be confined to a certain time period or accession number range. This is true regardless of whether the linear file is stored on magnetic tape or direct access storage devices. On the other hand, an inverted file on a direct access storage device permits the processing of only those records associated with the index terms selected for searching.

Since the time required to search a linear file is usually determined by the device on which the file is stored, for example, a magnetic tape drive, it is efficient to combine search requests into batches for processing. With an inverted file on direct access storage, there is little saving to be gained by batching searches.

The availability of a computer with large quantities of direct access storage, together with a desire to obtain short turn-around times for searches, were principal factors in STRC's choice of an inverted file structure.

D. Cost Considerations

For a linear file search system, the computer time for a small batch of searches is determined by input-output device speed. Cost per search decreases as the number of searches per batch is increased. When batch size increases sufficiently that the computing load slows the input-output process, search costs becomes a function of the number of search terms, the number of hits, and the number of searches per batch.

For an inverted file search system, computer time is initially determined by the speed of the (direct access) input-output devices and the amount of information read from the file. This is in turn a function of the number of the index terms, and the number of postings (i.e., documents indexed by that term).

E. Logical Capabilities

Search strategy input is in the form of a Boolean logic equation. The terms used in the equation must conform to those published in our search dictionaries, and the Boolean operations supported are "and", "or" and "not." The operators "and" and "or" can be used in any combination of terms and/or groups. The negation operator "not" can only be used in front of the last group in the equation. In negation, the results of the last group are logically subtracted from the combined results of the rest of the equation.

F. Saving Hits

The final hit list from every search can be saved in a special file, and may be later used as a logical group in a following search. This option, which must be specified at the time the search strategy is prepared, can be useful in reducing an undesirably large search output to a more manageable size by adding additional intersections or negations.

STRC uses this option for all searches whose results are to be transmitted by teletype. The saved hit list is retransmitted by the computer to a teletype terminal where a paper tape is prepared for use in transmitting the results by TWX. However, the saved hit list is automatically erased after transmission to our terminal, unless a specific request that it be kept is made. A maximum of 900 hits may be saved for any single search.

G. Other Options and Limitations

Searches may be restricted to a particular range of accession numbers. This can be accomplished by specifying that only one part of a multiple-part file be searched, or by specifying a beginning and ending accession number within a particular file. Only one accession number range may be specified for each file.

Various parameters of the STRC-IVS search system are limited to the maximum values shown in Figure 19. These limitations can be avoided if necessary by breaking a larger search into smaller searches, saving the results and using them as logical groups in a succeeding search.

SEARCH PARAMETERS WHICH HAVE A
MAXIMUM IN STRC-IVS

<u>Parameter</u>	<u>Maximum</u>
Terms per group	75
Groups per equation	30
Characters per term	30
Hits that will be saved	900
Postings per group	54,000
Number of accumulated hits at any time during a search	54,000

Figure 19

Searches of the NASA files may be restricted to machine or published terms.

H. Bibliographic Support

In the normal operating mode of STRC-IVS, the final hit list consists of a series of accession numbers. The documents identified by these numbers are evaluated by our staff by reviewing document abstracts. Card files of abstracts are now maintained for all documents in the NASA collection, and a proposal is under consideration by NASA to provide each Center with a complete set of abstracts on file cards for documents in the DDC collection. Until the DDC card files are available, DDC search hit lists can be evaluated by one or more of the following means. If a file of TAB is available, abstracts can be located by means of the indexes and reproduced. Abstracts can also be found in USGRDR. Those documents which are also included in the NASA collection may be located using the report number indexes in STAR, and the abstract reproduced from the NASA card files.

STRC has created an experimental bibliographic file for the 1969 portion of the DDC collection. A search hit list can be processed against this file to retrieve any or all of the following: title, author, corporate source, supplementary note, and abstract. Costs to retrieve bibliographic information from this file are higher than the costs of manual retrieval from a card file of abstracts. In addition, it is impractical to transmit bibliographic information by teletype because of the very low transmission speed (10 characters per second) of the teletype.

I. STRC Data Base

Figure 20 below lists the status of the principal data bases in use by STRC as of August 31, 1969. Several small files have been constructed for real-time searching under control of the Conversational Programming System (CPS). These files range in size from 300 to 3,000 documents and include both inverted files of search terms and linear files of bibliographic information. Some of these files are

Bills introduced in the 1969 session of the
North Carolina General Assembly

A small file on the properties of textile fibers

A small group of documents relating to water
pollution by textile plants.

STRC is providing assistance to various groups interested in constructing information bases for computer searching. These include a group at the School of Design, N. C. State University, interested in properties of construction materials and groups at the Department of Political Science and School of Library Science at the University of North Carolina in Chapel Hill.

<u>COMPUTER FILE</u>			
<u>FILE</u>	<u>Beginning Accession Number</u>	<u>Latest Accession Number</u>	<u>TOTAL ACCESSION NUMBER</u>
NASA-SAL	A63-10001 N62-10001	A67-43116 N67-40600	260,790
NASA-THE	A68-10001 N68-10001	A69-32820 N69-30400	106,481
ITT	T66-0001	T69-5103	36,679
DDC 64-68	AD-440 844	AD-676 971	73,403
DDC 69	AD-673 256	AD-688 059	10,365
ERIC	ED-000 001	ED-026 544	21,260

Figure 20

VI. SPECIAL PROJECTS

In addition to regular technology utilization activities, STRC has undertaken several special short-term projects which contribute to the overall program of the Center. The majority of these have been discussed in detail in technical reports submitted previously; however, a summary of each project is given here to present a complete picture of STRC activities.

A. Graduate Student Program

Realizing that graduate students form a group responsive to innovation and one soon to become influential in research, instruction, and administration, STRC conjectured that if this group could be shown the advantages of computerized literature searches, perhaps the impact on research and education would be significant. NASA agreed to subsidize a program to fit service within the budget capabilities of the average graduate student.

The service that was provided industrial subscribers at \$75 was offered to graduate students at \$5 in 1967-1968 and at \$10 and \$15* in 1968-1969. The program was limited to 155 students at twelve universities in 1967-1968 and 179 students at seventeen universities in 1968-1969. Special attention was given to North Carolina colleges because of their close geographical location to STRC and STRC's ties with the State government of North Carolina.

The president of each university was contacted by letter informing him of the objectives of the program and the services STRC might render and inviting him to participate. In each case, a dean or other faculty member was appointed by the president to coordinate a visit by STRC staff members to the campus. Faculty contacts that had been made in the previous year considerably aided the marketing effort by working with the presidents' appointees. The geographically more remote universities were asked to select 10 or 15 students to participate in the program. It is interesting to note that the eleven out-of-state universities were more cooperative than those in North Carolina in actually publicizing the service and in organizing a group to meet with STRC representatives. In addition, the out-of-state universities, either through the Graduate School or through individual departments, bore the search costs for the selected students. The North Carolina universities, on the other hand, were reluctant to commit themselves. Not only were they unwilling to support the program financially, but they also refused to organize student participation. Perhaps the reason for the difference between

* \$10 to North Carolina students and \$15 to students at other Southeastern universities.

local and out-of-state universities in their initial reception of the program lies in the fact that out-of-state administrators saw an STRC visit as a one-shot deal, whereas local officials knew they could reach the Center quickly and conveniently at any time they chose. The Triangle universities, whether justifiably or not, also seem to regard themselves as already providing the highest quality education available in the Southeast; they therefore feel that they need innovative measures less than do schools without their degree of development.

In the second year of the program's operation an effort was made to reach students in departments that had not previously been served. A concentrated attempt was made to bring physics and math students into the program. These students have been considered an important market to reach because:

1. There are more physics and math students (taking all schools together) than engineering students, since universities which may have only small or no engineering schools always include physics and math as major features of the science curriculum.

2. There is a great deal of information in the NASA file which is directly pertinent to these fields, especially physics.

It is interesting to note that although clients have been difficult to secure, the categories from which most documents were ordered in 1968-1969 were in physics.

Searches were run, usually within a week of the request date, against an inverted file on the IBM 360/75 housed at the Triangle Universities Computation Center, Research Triangle Park. After

machine processing, the abstracts for each accession number were then manually retrieved from a card file, evaluated by the engineer, reproduced and sent to the student. The number of evaluated hits sent to the student averaged 136 per search. The student could then order full copies of pertinent documents at 10¢ per page. However, he was encouraged to use his local university library wherever possible to secure these documents. Work order sheets, which followed each search as it progressed through the Center, were used to keep an accurate record of both the machine and labor costs of the program. (Exhibit A-7)

Generally, about two months after the student received his search, he was sent a questionnaire to complete. The questionnaire was designed to measure the student's satisfaction with the service in terms of what he received, his future job plans, and his field of interest. Approximately 90% of the search users completed the questionnaire.

In general, most of the students were satisfied with the service, irrespective of their field of interest. Sixty percent of the students found at least a few pertinent documents they had not seen before. Forty percent estimated they had saved an average of forty hours in the library performing a manual search for directly pertinent information or background information. About 30% felt they did not gain sufficient information to make the search worthwhile. The remainder gained what they considered to be valuable background or peripheral information they would not have found ordinarily. Use of computerized information retrieval services would be unconditionally recommended to future employers by a majority of the students.

Although costs of the search program were met largely from research grants or university resources, a few of the students indicated they would be willing to pay out of personal resources. However, the amount they were willing to pay did not meet the cost of providing the service. It is evident that a considerable subsidy will continue to be required to make this service available to unsupported graduate students generally.

The major complaint with the service as now constituted is the file's lack of breadth, particularly in the chemical area. Although some students regarded the articles as too technical, this may only be an indication of poor research techniques and lack of sophistication in applying the methods discussed in the literature provided.

A significant feature of the program which contributed greatly to its acceptance was the designation of a single person to receive all student requests, follow through on processing and carry on the oral and written correspondence associated with each search. With this procedure, the student could always contact the same person, someone who was familiar with the status of his search. The rapport thus established contributed to the student's feeling that the organization was interested in more than his money. Administratively this was highly successful in that the status of each search or a group of searches could be easily established.

Probably the most important single factor for insuring a successful search output is communication between the STRC applications engineer and the search requestor. For this reason, a personal conference was conducted for each search between the appropriate applications engineer, armed with NASA thesaurus and

dictionary, and the student, who was encouraged to bring with him to the conference specific notes on his interest area. The ensuing discussion involved a concerted effort on the part of both the engineer and the student to find the precise key words to describe the student's particular question and to combine those key words by Boolean equation to obtain maximum output from the NASA collection.

The program to provide low-cost literature searches to graduate students has, it is felt, led to improvements in the quality of the research performed by the participating students. STRC is continuing this program and has enlarged marketing efforts to include libraries on university campuses. It is hoped that librarians will be trained to write programs and operate slow speed terminals connected to a computer which serves a number of libraries, providing access to a number of files stored and updated at the computing center.

It is believed that such a program will substantially improve the research performed at institutions with large library holdings or those poorly connected with federally-supported research programs. The major costs of such a program are those of file construction and maintenance. Since construction of literature files is likely to be considered by more and more disciplines in the future, ways will be found to spread the cost. It is desirable, however, that the format and search systems be compatible so that inter-disciplinary searching is encouraged. To obtain the maximum benefit of implementation of such a program, a variety of files (from trade journals or literary or opinion journals, for example) should be included and undergraduate students from every field be encouraged, as a part of their course work, to use the system.

B. STS Searches

As part of its contribution to the N. C. State Technical Services Program, STRC prepared a series of retrospective searches on topics of general interest to a variety of industries. These differ from the usual STRC search in several ways:

1. each bibliography contains a review of the abstracts cited;
2. the foreword also lists those documents which should be of interest to various industries;
3. applications engineers have suggested possible applications of the technology involved; and
4. the searches are much broader in scope and less detailed than the normal STRC searches for subscribing clients.

An announcement of the availability of these searches at no cost was first published in the April 1969 issue of the Industrial Extension Service Newsletter at NCSU. In July 1969, we included a story on the searches in TECH TOPICS. From these two announcements have come requests for 180 copies of the searches. It is ironic to note that half the requesting companies are already subscribers to STRC services; companies not familiar with information retrieval systems did not take advantage of the search service, even though free.

Titles of the searches offered to industry are listed below. Figures in parentheses indicate number distributed by STRC through August 31, 1969.

Pert and Cost/Pert (10)
Zero Defect Programs (3)

Manpower Training (3)
 New Development in Polymer Chemistry
 and Physics (9)
 Recent Developments in Numerically
 Controlled Processing (2)
 Surveying Large Regions for Rainfall
 Distribution (1)
 Developments in Machine Design Methods (6)
 Waste Water Reclamation (6)
 Storage of Cryogenic Fluid (1)
 Lightweight Protective Clothing (4)
 New Methods of Mineral Prospecting (3)
 Air Pollution Control (9)
 Highway Safety (2)
 Adhesives Progress (6)
 Wear Resistant Materials (3)
 High Modulus Materials (4)
 Flow Visualization Techniques (3)
 Fireproofing Materials (8)
 Progress in Metal Forming, Shaping,
 and Fabricating (5)
 Advances in Packaging Technology (5)
 Material Handling Systems (3)
 Containerized Shipping (2)
 Thermal Insulation (6)
 Safety Engineering (1)
 Protective Coatings in the Marine
 Environment (2)
 Electrostatic Processes for Industry (2)
 Information Storage and Retrieval (13)
 Effect of Molecular Structure on
 Textile Properties (7)
 Preparation and Properties of Carbon
 and Graphite Fibers (5)
 Emulsion Polymerization (8)

Finishes for Glass Fibers in Plastic
Composites (6)
Flow of Air and Steam in Pipes and Ducts (4)
Deposition of Metals for Bright Surfaces (2)
Damping Fluids (2)
Lead Poisoning (2)

Each search is divided into logical sections. For example, the search on Air Pollution Control has seven sections: (1) discusses the general topic of air pollution control and contains abstracts of symposia and articles of general interest; (2) and (3) deal with the sampling, analysis, and removal of chemical pollutants; (4) and (5) cover sampling, measurement, control, and removal of physical pollutants; (6) discusses design of stacks and diffusion of effluent from the stacks; and (7) deals with contamination from biological sources. This search area is of immediate interest and was used as a literature source at a symposium on Air Pollution held at Raleigh, N. C. on September 24 and 25. The symposium was attended by 80 interested industrial personnel and educators.

STS search #1759, Noise and Hearing Conservation, will constitute part of the literature to be discussed at the Noise and Hearing Conservation for Industry Seminar to be held in Charlotte, N. C., on October 31, 1969. Both seminars are sponsored by the Industrial Extension Service and interested departments at North Carolina State University.

C. Marketing Study

A comprehensive analysis of the potential market for STRC services in the southeastern United States was completed in February 1969. Included in this study were the following elements:

1. A description of significant characteristics and procedures used in the survey;
2. A priority listing of potential clients;
3. Identification of companies affected by access to the Chemical Abstracts and Institute of Textile Technology files;
4. A tabulation of potential clients by states;
5. An evaluation of marketing efforts to date.

A final tabulation listed 50,449 manufacturing units studied, of which only 426 or less than 1 percent showed significant potential as future clients of STRC.

In the second stage of the marketing study, data were collected to determine the extent to which the STRC marketing program had approached the potential market group. Records dating back to January 1, 1966, were searched to learn the number of letters, phone calls, personal visits, searches, documents, updates, and selective dissemination provided each company.

The study indicated that 269 companies received at least two generalized sales letters. Individualized attention was given 65 companies in addition to the two generalized sales letters. The attention devoted to the remaining 92 companies exceeded these levels; this is particularly true for those who became clients for at least a year.

In general, one can conclude that each subscription requires a carefully planned, aggressively pursued, time-consuming marketing program; for each subscription secured, many other such programs will be unsuccessful. Client service can be thought of as an extension of the marketing program; thus, resubscription is to a large extent dependent on the quality of the service rendered.

To some extent there is room for improvement in both marketing effort and service of the prospective client list. On the other hand, the effort expended on the present market groups appears to be greater than is usual in this type of enterprise. It must be remembered, too, that few companies are convinced that information services of the type purveyed by STRC are a necessary business expense as is insurance.

D. Cost Study

An analysis of cost records maintained by STRC resulted in the adoption, in the summer of 1968, of a job order system for all search services to all classes of subscribers. A job-cost record card (Exhibit A-5), issued whenever a search is instituted, is used to collect data on costs incurred in performing subsequent documentation. These cost records have been summarized periodically to develop average costs for services provided by STRC.

In May and June of 1969, an extensive analysis of the cost records was conducted, covering the period from mid-September 1968 through the end of February 1969. Based on this study, all STRC services were repriced. Separate charges are now made for search services and for the provision of document copies, the study having revealed that former pricing was inadequate to cover STRC's costs. Document copies are now charged to the customer on the basis of the actual cost to STRC.

Two computer programs were also prepared to summarize and analyze cost data from various records maintained at STRC, including the job cost records. Labor cards prepared by all employees were summarized to insure that costs only indirectly related to a particular search were not overlooked in pricing services. The

programs were used in 1968 and are available for current use. The STRC staff is now working on a means of recording and analyzing time spent on the Graduate Student Program, which may eventually be applied to all STRC services.

E. General Assembly

Using the real-time search system, STRC personnel created a file composed of a subject index to the bills introduced in the 1969 North Carolina General Assembly. The system provided assistance to the unsophisticated user, accepted index terms and logical connectors, and provided an output of bill number, short title, and introducer's name. Access to the computer was through IBM Type 2741 typewriter terminals and the commercial dial telephone network. STRC staff also supervised the preparation of weekly indexes for legislation introduced during the 1969 session of the General Assembly. The cost of this project was supported entirely by the N. C. Board of Science and Technology.

VII. IMPACT REPORTING

In the early months of the RDC program in North Carolina, we tried to pinpoint the effects of specific transfers of identifiable documents to particular companies, and then evaluate the benefits of these transfers in dollar-profits or man-hours saved. Too often the company involved was unaware of the original source of information and could not confirm any transfer; frequently, no one document could be cited as solving a certain problem.

In staff discussions, it became apparent that the role of this particular RDC is not that of instant problem-solver. We reviewed the services performed for the majority of our long-standing clients, and found almost without exception that the part

played by STRC was in continually supplying its clients with information on the latest state-of-the-art for current awareness, plus well-formulated retrospective searches when needed.

The steady stream of document orders from our longstanding clients indicate that the searches, both retrospective and current awareness, are pertinent and that engineers are evaluating abstracts in terms of client needs with precision and understanding. That the clients have come to expect this and to accept this role of the RDC is apparent in their continued subscriptions, often on an increased level. We feel that we have become an established and accepted part of the information resources of our clients.

The case histories which follow illustrate STRC's participation in information retrieval for industry in the Southeast during the contract period.

CASE NO. 66

In its Seventh Quarterly Progress Report, dated March 31, 1966, STRC reported assistance given Mr. Joseph Pearsall, an independent inventor of Durham, North Carolina, on development of a carbon monoxide detector. With the cooperation of its chemical and electronic engineers, STRC ran searches in the areas of chemistry, biosciences, and auxiliary systems. Mr. Pearsall was referred to the Small Business Administration, a patent attorney, a supplier of platinum-coated wire, and to an independent research organization.

In March 1967, a meeting was arranged between Mr. Pearsall and an electrochemist at Duke University in Durham for further laboratory investigations.

Recently, Mr. Arthur Lockwood, STRC chemical engineer, contacted Mr. Pearsall to determine the present status of the project. He was told that investigations aimed at finding an alternate catalyst for manganese dioxide, which has a very short life, are being continued by Dr. E. C. Toren, the electrochemist from Duke. Dr. Toren is presently on sabbatical in Europe, where some of the work will be done in association with a Ph.D. candidate, also from Duke.

Mr. Pearsall was most appreciative of the help given by STRC from the beginning of the project. Although the detector is still not patented, its development is progressing satisfactorily and no barrier to its patentability has been discovered.

CASE NO. 106

As reported in STRC's Thirteenth Quarterly Progress Report, Client No. 0354 has requested assistance from STRC in determining the cause of excessive corrosion on cylindrical tubes used as a piston in hydraulic car lifts. Roller burnishing was being used to obtain the final finish.

After a computer search of NASA material and a manual search conducted at North Carolina State University had revealed little of value on the subject of roller burnishing and corrosion, STRC arranged for a consultant metallurgist, Mr. Jerry Waller, to visit the client's facilities. A diagnosis of several distinct forms of corrosion on the tubes was made by Mr. Waller, and samples taken for more detailed laboratory analysis. The Fourteenth Quarterly Report discusses aspects of the problem at length.

Following extensive research and analysis, the consultant reported that the burnishing operation significantly increased the corrosion susceptibility of the tubes. This finding has now led the client to eliminate the burnishing operation from the manufacturing process entirely and to substitute centerless grinding.

An exact evaluation of the economic benefits in the case has yet to be made. The client had been experiencing greater difficulties with corrosion than had its competitors; any reduction of problem areas with a product increases the strength of that product in a competitive market, and eventually should result in greater dollar profits for the company.

In this particular case, STRC was able to provide the client with expert diagnosis and recommendations which, it is expected, will eliminate a serious deficiency in the client's product.

CASE NO. 24

Dr. F. O. Smetana, assistant director for operations and professor of Mechanical Engineering at North Carolina State University, acted as consultant to an STRC client which has since converted from an "on-demand" basis to a full subscribing contract.

The client industry (0234) intends to do some fundamental studies on the physics of fibers at low temperatures and pressures. Dr. Smetana advised them on the construction of vacuum Dewars for liquid helium service which could also be used to perform tests for this work.

CASE NO. 108

As a follow-up to Case.No. 108 reported in the Fifteenth Quarterly Progress Report, Technology Utilization Manager J. Graves Vann, Jr., contacted a client manufacturing firm to determine the effectiveness of search material forwarded to the client several months ago. The most pertinent and useful documents to the firm were:

N64-14631 - Lightweight Reinforced Plastic Faced
Sandwich Construction
A66-12769 - Strength of Sandwich Panels with Thin-
Film Facings and Foam Cores
A64-24353 - Elastic Behavior of Low Density Rigid
Foams in Structural Applications
Forest Products Laboratory Report No. 1838
Forest Products Laboratory Report No. 1847

Mr. Vann also submitted reports from other sources, including open literature, the Department of Defense File, and some additional Forest Products Laboratory reports. Technology contained in STRC-furnished documents was not incorporated in its entirety in any instance, but rather guided or confirmed the soundness of the final design of the product under development.

The company has developed a truck body which features a unitized structure of sandwich panels and eliminates all skeletal structure above the truck bed. With framing deleted, the truck body weight is reduced by 45 to 50 percent.

The prototype has been installed on the truck of a dairy products company for practical testing, and is now being modified

to eliminate some difficulties. Also in use is an export version, a collapsible unit that can be erected on site, thereby vastly reducing the shipping volume to the point of use. This model is not in broad distribution, although the company expects the design to gain popularity.

Primary modifications of the export body involve the substitution of metal skin panels for reinforced plastic panels and the use of mechanical fasteners, as opposed to adhesive joints on body panels. The first modification resulted from the differential in expansion of the core material, foam, and the reinforced plastic skin. Degradation of adhesive joints prompted the use of mechanical fasteners.

The process of manufacture is new, although it employs a number of capabilities that are well developed in this company. The assembly method is novel and promises to be a very efficient procedure as it is developed. A modular building technique has been attempted but not fully carried out in the bodies mentioned above. However, it is felt that the process can and will be utilized to achieve flexibility of design.

The operators of these trucks may expect cost reductions in truck weight, maintenance, and in such operating expenses as fuel, tires, refrigerating costs and licensing. The manufacturer may well see reduction in fabricating and overall material costs while achieving an expansion of the company's capabilities. Techniques were also developed which the client firm expects to utilize in the development of an entirely new product.

CASE NO. 112

A unique case of impact by information transfer has been added to STRC's growing file of case histories. The company's problem was actually solved by a bibliography, with no supporting documents.

Uniroyal Fiber and Textile Company, a division of Uniroyal, Inc. (formerly U. S. Rubber Company), in Winnsboro, S. C., was quite cool to STRC's first approach, a letter from assistant director for marketing L. M. Kelly in February 1968. However, a meeting in July 1968 between Kelly, A. W. Lockwood, STRC application engineer, and Dr. G. R. Cuthbertson of Uniroyal resulted in a trial subscription on a minimum basis, with service not to begin for several months.

Uniroyal's first retrospective search, "Ageing of Glass Fibers," was forwarded about the first of October. This bibliography contained 150 abstracts having a direct bearing on the subject. A month later, no documents having been ordered, Lockwood telephoned Dr. Cuthbertson for an evaluation of the search. Dr. Cuthbertson was very enthusiastic, and said that the search was an excellent one. The bibliography alone solved the immediate problem, he stated, and this was why they had ordered no documents.

Uniroyal researchers had observed a loss in tenacity of glass fibers upon ageing, yet the suppliers denied that such a loss occurred. The bibliography included a number of references to this loss in strength and Dr. Cuthbertson was therefore able to use STRC's search as ammunition in discussions with suppliers.

STRC has also carried out a search on asbestos fibers, which proved to be of much value to Uniroyal. In addition, the client has established a monthly update interest area on flame-resistant fabrics. With these services, the trial subscription has been exhausted in two months time, and Dr. Cuthbertson has requested a renewal proposal at considerable increase in service level.

Attached is a letter from Dr. Cuthbertson to the applications engineer and copies of some of the pertinent abstracts useful to Uniroyal.

18

N66-22690# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.

THE EFFECTS OF MOISTURE ON THE STRENGTH OF GLASS FIBERS: A LITERATURE REVIEW

W. H. Otto Jun. 1965 51 p refs

(Contract Nonr-4522(00)(X))

(AD-629370) CFSTI: HC \$3.00/MF \$0.50

A review of literature pertaining to the effects of moisture on the strength of glass fibers is presented in three (3) sections. The research on massive glass has been abstracted to provide background and general knowledge of the moisture effect. The limited information on uncoated glass fibers verifies at very high stresses the predictions based on massive glass studies and further elucidates the degradation mechanisms associated with environmental moisture. The literature on coated fibers discloses the minimal technical advances which have been made to retain the very high intrinsic strength of the fiber, particularly in protection from the strength-degrading effects of moisture. Author

N67-25657 Chemical Lab. RVO-TNO Rijswijk (Netherlands).

TENSILE STRENGTH OF GLASS FIBER FILTERS [DE TREKSTERKTE VAN GLASVEZELFILTERS]

J. F. van der Wal and L. A. Clarenburg Nov 1966 10 p ref

In DUTCH. ENGLISH summary

(TDCK-47117, Rept. 1966-21) CFSTI: \$3.00

An experimental investigation is described of the factors influencing the tensile strength of glass fiber filters. No binder was added to the filters. Results obtained indicate an increasing tensile strength at decreasing fiber diameter. Moreover the tensile strength decreases as the pressure, exerted on the filters during the manufacturing process, increases. Finally the tensile strength decreases at increasing storage time. Author

North Carolina Science and Technology Research Center

18

N65-19022# General Electric Co., Evendale, Ohio Advanced Engine and Technology Dept.

INFLUENCE OF STRESS CORROSION ON STRENGTH OF GLASS FIBERS

D. L. Hollinger, W. G. Kanetzky, and H. T. Plant 30 Nov. 1964

21 p refs

(Contract Nonr-4486(00)(X))

(BMPR-4; AD-609985)

Static fatigue tests at liquid nitrogen temperature were completed on virgin E-glass single filaments. In these tests, fibers approximately 0.0005-inch diam were dead-loaded in tension while at -196°C and maintained at that temperature for at least 1.7×10^5 seconds. Loads were varied within the high stress region from 400 000 to 650 000 psi. No static fatigue failures were observed under these conditions, even though the stress range was high enough to cause immediate failure of some fibers upon load application. This is in distinct contrast to the behavior observed at room temperature in normal humidity where delayed failures occurred over several decades of time with stress level ranging from 200 000 to 400 000 psi. Author

18

N65-25885# General Electric Co., Evendale, Ohio Flight Propulsion Lab. Dept

HIGH STRENGTH GLASS FIBERS DEVELOPMENT PROGRAM, TASK 2 Final Report

D. L. Hollinger, H. T. Plant, R. F. Mulvey, and T. J. Jordan

20 May 1963 50 p refs

(Contract N0w-61-0641-c(FBM))

(AD-405897) CFSTI S125

The influence of moisture on the effective strength of E-glass fibers, both as single monofilaments and when incorporated with epoxy resin into filament-wound ring structures, has been investigated. Humidity in the atmosphere surrounding the fiber was controlled during various periods in its history. Split ring tensile tests on the composites showed a definite advantage for the maintenance of dry surroundings throughout all processing steps. Furthermore, these indicated that the greater significance in determining strength than mere exposure to moisture during other periods. Thus, a stress-activated corrosion reaction was suspected to be causing large strength losses during the actual testing. Work with single bare fibers of E-glass has served to verify the importance of this stress corrosive reaction. Author

18

N65-22483# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics

AN INVESTIGATION INTO THE EFFECT OF ENVIRONMENTAL TREATMENTS ON THE STRENGTH OF E-GLASS FIBRES

N. M. Cameron Jan. 1965 164 p refs

(Contract N0w-64-0178-d)

(T&AM-274; AD-456850)

Various experiments were carried out to determine the effects of certain environmental treatments on the load carrying capacity of virgin glass fibers. The state of the fiber surface, during and after environmental treatments, with the tensile strength used as a characteristic measure of state was also examined. The effect of strain rate on strength was also studied in the range 0.01 in/in/min to 10 in/in/min. Fiber strength in vacuum was found to increase with time. Subsequent envelopment in dry nitrogen gas at atmospheric pressure and at

room temperature did not influence the observed strength, but at nitrogen gas temperature below room temperature a strength resulted which was a function of both the temperature and the time of prior evacuation. Maximum value was reached at liquid nitrogen temperature. The standing of fiber samples in air decreased their strength; heating of stressed and stress-free fiber specimens led to large reductions in strength as the heating temperature was raised. G. G.



UNIROYAL FIBER & TEXTILE

Division of UNIROYAL, Inc.
350 Columbia Road
Winnsboro, S. C. 29180

November 26, 1968

Mr. A. W. Lockwood
Applications Engineer
N. C. Science & Technology
Research Center
Research Triangle Park, N. C. 27709

Dear Mr. Lockwood:

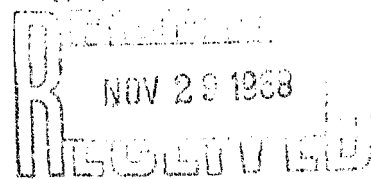
We have received three searches from you within the last few months and have found them very useful. The search on the "Aging of Glass Fiber" confirmed some of our lab findings that glass fibers do shelf age which seemed contrary to general information available. We are further studying the contents of the search to determine if there is information available on how to arrest this deterioration and will be in touch with you for a document or a continuing search. The search on asbestos fibers and yarns has pointed out that there is information available on the processing of asbestos that could be useful in a new project we are undertaking. The continuing search on non-flammable fabrics should keep us up-to-date on this very important subject.

We thank you for your quick and efficient service. Previously, such searches would have taken months. It seems as though I hardly had requested the search until I had the information on my desk. Congratulations!

Sincerely yours,

G. R. Cuthbertson
G. R. Cuthbertson

/dht



CASE NO. 113

The purpose of this case history is to illustrate the fact that there are certain small unsophisticated production-oriented companies in the Southeastern United States whose needs cannot seemingly be met by the NASA information bank. The company selected to illustrate this point manufactures and sells the silver nitrate and dextrose (reducing agent) solutions used in mirror production. Their customers are, obviously, mirror manufacturers. To a lesser extent, they sell to a few companies manufacturing room accessories. The company is quite small, employing a total of perhaps 25 people. There is a President, Vice-President, chemist, two secretaries, one or two foremen, and the remainder are production workers.

The president of this company was referred to STRC by an official of the Research Triangle Institute. First contact was made on February 4, 1967, when the company was visited by three applications engineers, V. M. Cordle, L. H. Libby, and J. G. Vann. Because of the silver shortage, the company wanted to find a new process for making reflective surfaces on glass using a cheap abundant metal which can be supplied in solution form. A proposal for \$300 was signed during this meeting. In addition, Libby agreed to make arrangements with a consultant at NCSU to carry out some plasma arc and flame spraying experiments to determine if any of these techniques show potential for preparing mirror surfaces. Also, Libby agreed to explore the possibility of bonding aluminum foil to glass with a clear adhesive. Thus, considerable free consulting service was given during the initial meeting.

The first retrospective search was forwarded on February 20, 1967. Bibliography No. 864, "Mirror Coatings," contained 131 computer citations, and 25 abstracts deemed most pertinent by Cordle. Two weeks later, in a follow-up move, Cordle telephoned this client asking why no documents had been ordered.

The second search, this one a manual search of Chem Abstracts, on the same subject, 1957-1965 was forwarded on March 29, 1967. A total of 24 abstracts were sent to the client. The client ordered 11 of these references about a week later. Among these were four foreign patents which the client was anxious to receive in translation. Cordle went to considerable time and trouble trying to find an English source, but was unsuccessful in this effort. Much correspondence was carried out during the period April 6 through May 26 in this pursuit. Finally, on May 31, to complete this second search, Cordle forwarded 5 abstracts obtained from a manual search of Chem Abstracts, January through October 1966. None of these were ordered by the client.

Meanwhile, on May 3, the client ordered 9 documents from the first search. This order was completed on May 22.

On June 21, Cordle learned that this client had retained the services of a consultant to explore the possibilities of deposition of mirror coatings by means of low-temperature plasmas. The client and the consultant made contact at a symposium sponsored by STRC in April 1967.

In August 1967 the client requested a copy of an article, "Simplified Guide to Thermal-Spray," which was immediately forwarded to him.

In November 1967 Lockwood joined the agency and assumed responsibility for this client, as Libby and Cordle had both resigned. He instituted a policy of at least one contact per month with each of his clients. As the client had not set up a monthly update interest area, Lockwood decided to forward documents on a basis in a selective dissemination program, if any documents in the client's interest area were to be found.

On February 23, 1968, Lockwood visited this client and discussed renewal of their proposal for a second year. During the meeting, two topics for retrospective searches were developed with the result that the client signed a renewal proposal for \$150.

The first search was forwarded on March 12, 1968. Bibliography No. 1227, "Surfactants Compatible with Stannous Chloride," contained 740 computer citations, and also 20 abstracts which Lockwood deemed most pertinent. This search arose out of the client's interest in combining two of the six steps in finishing gold-tinted plastic household accessories. He hoped to apply the wetting agent and the stannous chloride in one application instead of two, as is the custom now. There were no retrievals directly pertinent to the problem addressed and no documents were ordered.

The second search was forwarded on March 25, 1968. Bibliography No. 1228, "Deposition of Metals for Bright Surfaces," contained 2,000 computer citations, plus 75 abstracts judged by Lockwood to be most pertinent. This subject arose out of the client's general interest in finishing plastic room accessories (such as gold-plated candelabra). Although many retrievals seemed pertinent in a general fashion, the client failed to order any documents from this search.

On May 30, 1968, while visiting another client in the same city, Lockwood stopped by this client to leave a document. This visit proved most opportune in that communication with the consultant engaged a year earlier had reached a low ebb. It so happened that the consultant had already planned to visit STRC four days later, and Lockwood invited the President and Vice-President to visit STRC on that same date. They readily accepted and the meeting at STRC on June 3 between client and consultant resulted in improved communications and the re-establishment of cordial relationships. The client was very appreciative of STRC's role in this encounter.

Throughout the remainder of 1968, Lockwood continued to forward documents to the client in his selective dissemination program. Early in 1969 (February 5) he again visited the client for the purpose of discussing renewal for a third year. The client had already made up his mind not to renew, saying very frankly that he had received absolutely nothing of real help during the past two years. During the ensuing conversation, however, Lockwood persuaded him to give STRC one more chance, and he agreed to set up a monthly update subject on deposition of metal coatings, to keep himself current during the coming twelve months. He signed and returned a proposal on February 11, 1969.

Lockwood's visit prompted a re-evaluation of earlier searches by the company chemist. On February 18 the chemist ordered a document (A65-11511) from Search 1228, forwarded almost a year earlier.

The question arises: Why was this company not able to make use of the approximately 40 documents and 150 abstracts forwarded to it over a two-year period? A knowledge of the company combined

with an examination of these documents suggests an answer to the question. The documents may in general be grouped in two categories: those dealing with chemical-spray techniques involving a certain amount of developmental work to reap the benefits; and those relating to other techniques for obtaining reflective surfaces. In the first case, this company is so small that the management most likely does not have at its disposal the funds, time, or manpower to carry out the necessary development work suggested by these reports. In the second instance, although academically interested in all forms of metal deposition, the management is essentially committed to the chemical-spray application technique.

A survey of typical documents forwarded to this company supports the above logic. For example, document A67-34914 presents an excellent discussion of the theory and practice of electrodeposition of metals in an ultrasonic field--a subject of academic importance only as far as this client is concerned. Again, NASA TN D-4506 deals with the quantitative measurement of vapor deposition nucleation processes by in situ electron microscopy. Here vapor deposition is a technique unlikely to attract the client's professional efforts, and further, such a sophisticated analytical technique as that described is far beyond his current needs. N66-38738 also deals with electrodeposition. N67-27262 discusses vapor deposition techniques. NASA TN D-4889 details quality control testing of aluminum solar concentrators for vibrational and heat stability, but under conditions that commercial earth-bound mirrors will never approach. Finally, our example, NASA TN D-4734 gives explicit instructions for coating magnesium with epoxy resins by spray techniques; apparently, however, the client chose not to invest the time, effort, and money involved in attempting to adapt this technique to his own needs.

It is important that all agencies concerned with technology transfer recognize that the response of this firm is not atypical. In general one can propound the rule that a company does not adopt new technology unless it is assured of recovering its investment within a very few years. With the narrow margins between sales and cost now existing in most small industries and the high cost of technical talent, such adoptions are increasingly unlikely in the near future.

CASE NO. 114

A major tobacco company, interested in diversifying its products, had requested STRC to conduct a search on sputtering employed as a technique for the desposition of thin films and coatings. From this search, the company had ordered large quantities of full documents--77 reports from the 144 abstracts submitted with the bibliography. STRC staff members felt that the client did not understand the true concept of a Regional Dissemination Center and was, in fact, filling its library shelves with reference material in which it might, someday, have an interest.

A candid discussion between the librarian and applications engineer Vann disclosed that this was quite contrary to the facts.

The client has underway a bona fide project in which an unusually large number of scientists and engineers are engaged. The documents ordered from STRC represent essential homework to provide an adequate background of technology relevant to this particular project. Prior to the search made by STRC, the company had nothing in its library on the subject. The strong support for the project has come almost entirely from the NASA collection.

CASE NO. 115

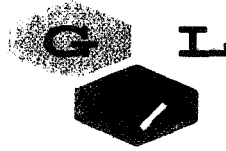
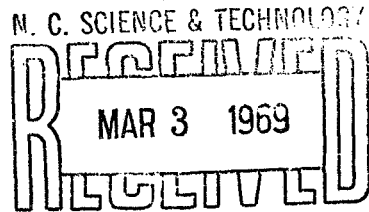
Early in February, applications engineer A. W. Lockwood received a telephone request from Great Lakes Research Corporation in Tennessee. Could STRC supply the latest state-of-the-art on carbon-graphite sealing rings for high-temperature application? Could Great Lakes have the material in no more than three days time?

Mr. Lockwood ran the search the same day and nine full documents were ordered. Within three days of the original request, all material from STRC was in the hands of Dr. Fred Shea, Research Director.

Mr. Lockwood then called Great Lakes to ask if the information was sufficient and of value. The client assured him that the help of STRC in this case was invaluable and gave Mr. Lockwood the background of the request.

Great Lakes had been requested by NASA to submit a research proposal in the area of sealing rings for turboshafts. By reviewing the documents forwarded by STRC, Great Lakes determined that they were as knowledgeable in the field as anyone else and that they had the capability of performing under the contract. With this background, Great Lakes was able to submit the proposal by the date required. Mr. John Hardin, Business Manager of Great Lakes, pointed out STRC was the only source of such information known to Great Lakes.

Attached is a letter of appreciation to Mr. Lockwood from Mr. Hardin.



GREAT
LAKES
RESEARCH
CORP.

Elizabethton, Tennessee
Area Code 615
Phone 543-3111

February 28, 1969

Mr. Arthur W. Lockwood
North Carolina Science and Technology Research Center
P. O. Box 12235
Research Triangle Park, North Carolina 27709

Dear Mr. Lockwood:

This letter is being written to express the appreciation of Great Lakes Research Corporation for your assistance, on very short notice, in providing us with a literature search and reprints of documents relative to Carbon-Graphite Seal Rings.

This information was used to assist us in preparing a research proposal for NASA on "Carbon-Graphite Materials for High Temperature Seal Ring Application". Without your assistance our proposal would have been incomplete.

We look forward to working with your organization on future matters of this type.

Sincerely,

GREAT LAKES RESEARCH CORPORATION

John E. Hardin
John E. Hardin
Business Manager

CASE NO. 116

The Biomedical Applications Team at the Research Triangle Institute was interested in the application of ultrasonics to diagnostic techniques. The researcher involved needed general information on ultrasonic techniques, and STRC was asked to conduct a manual search of the NASA information system.

Two publications were selected as particularly relevant: N67-26949 and N67-29114, "A Report Guide to Ultrasonic Testing Literature," Volumes III and IV, Monograph Series, 1967. These documents are extensive bibliographies of ultrasonic testing literature.

The material was forwarded to Dr. W. M. McKinney, Bowman Gray School of Medicine, who estimated that these documents represented a savings of his time of from \$5,000 to \$7,000, providing supportive background information for his continuing research.

CASE NO. 118

The Biomedical Applications Team (BATEam), a regular STRC client, requested a search concerning the instrumentation of wind tunnels. BATEam, as a function of their technology transfer program, forwarded the information to Dr. V. A. Tucker, of the Duke University Zoology Department.

Dr. Tucker is interested in the aerodynamics and energetics of flight, with reference to an aspect of avian flight, dynamic soaring. The use of vertical motions of air or updrafts is well understood. Dynamic soaring, the use of changes in horizontal wind velocity to obtain lift, if understood, might be applicable

to aircraft flight.

In conducting his studies, Dr. Tucker carried out wind tunnel tests on small airfoils related in shape to birds. One of the basic tools of wind tunnel testing is a balance which is used to measure the forces and moments about an object in a wind tunnel. To aid in the interpretation of data obtained with a balance it is important that the angle of the airflow relative to the model axis be known. Instruments which make such measurements are often called yaw meters. Dr. Tucker requested information which might enable him to obtain an improved balance and adequate yaw meter.

The computer search produced a Russian document, N67-21381, "Wind Tunnels and Their Instrumentation." This document provided Dr. Tucker with information which he adapted to build a new yaw meter, thereby improving measurement techniques. Dr. Tucker stated that the source of information citing a pertinent document until then unknown and the availability of the Russian document in translation were invaluable to his study.

CASE NO. 119

Not all transfers are identifiable NASA documents; sometimes impact takes the form of identification of problem areas, referrals, or recognition of potentials. The following is an example of the latter two.

In March 1969 Technology Utilization Manager Graves Vann called on a prospective client in an effort to stimulate interest in the overall TU program and STRC in particular. The prospect, a large producer of lithium compounds, was apparently not too interested in retrospective searches of the NASA data collection,

but did have a problem at its ore concentrate operation.

The problem concerned the deposition, profitably if possible, of waste material composed basically of sand and finely crushed stone. Mr. Vann recognized its potential in a number of areas, such as asphalt filler, filter beds, and decorative finishes, and was able to refer the prospect to a major crushed stone company which was interested in acquiring the waste material. As of the end of the report period, the two concerns were negotiating a mutually profitable agreement. DOLLAR VALUE: 200-300,000 tons per year at approximately \$1 per ton.

CASE NO. 120

STRC client no. 0202 requested information on "Computer Programs for Thermal Distribution" in a continuing search for a better program for 3-dimensional heat transfer. The engineer making the request was currently using his company's own program, but was looking for a better, faster program if available.

STRC bibliography no. 1792 cited a number of abstracts on the subject, two of which listed the client company as the source of an updated, improved program for heat transfer. The client engineer was able to acquire the program in-company with no additional expenditure of time or money.

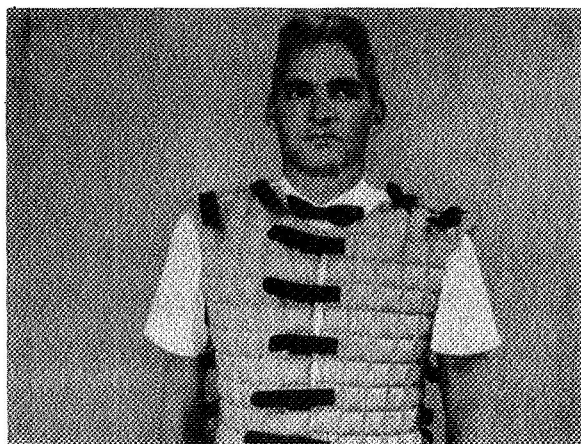
CASE NO. 121

The Biomedical Applications Team at the Research Triangle Institute had been interested in electrocardiogram (ECG) electrodes implanted in a vest adjustable for both sexes from ages 3 to 16 years, utilizing up to 150 electrodes. Such a vest would allow

investigators to attach many electrodes to a child's body easily and rapidly. Ordinarily several hours would be required for the task, which provides simultaneous analysis of data from the electrodes. A computer search on the problem had been run, but it contained no information on vests.

In an informal session with STRC engineer T. R. Potter, E.E., the question was raised as to a local source for the manufacture of such a vest. Mr. Potter was familiar with the capabilities of Payne & Associates, a former STRC client near Raleigh engaged in the manufacture of life rafts, flotation bags, buoys, anti-exposure garments, and life vests. He suggested this company to BATeam, and contact between the two organizations was made.

The photograph below shows Mr. Potter wearing a prototype vest, still in its experimental stage, and without electrodes. The vest is made of coated nylon with straps of Velco to permit maximum adjusting. Inflation by hand-pump ensures good contact for all electrodes, one of which will be attached at the vertex of each quilted square.



At the close of the current contract period, the prototype vest had been delivered to the researcher for evaluation and modification.

Although it is impossible to assign a dollar value to Mr. Potter's referral, one can assume that the immediate identification of a local and well-qualified manufacturing source has saved many man-hours in locating such a supplier.

CASE NO. 122

An innovation developed at the NASA Langley Research Center and demonstrated there during the "Aerospace Related Technology for Industry" conference in May 1969 was the chain damping system for reduction of oscillation in tall cylindrical masts. Originally designed for use with antennas, the system consists of a cluster of chains enclosed in a neoprene shroud and suspended inside the mast from the top. Wind-induced bending has been greatly reduced by the use of this system; one antenna showed less vibration at 60 knots than an undamped one had at five knots.

STRC engineer Leon Neal recognized the usefulness of this system for a client interested in outdoor lighting standards. When he returned to STRC, he forwarded two documents (N68-26832 and N68-25354) to his client as selective dissemination. The client received the material enthusiastically and told Mr. Neal that the company had indeed been having problems in that area, especially on highway bridges where the vibrations from heavy traffic affected street light standards appreciably. At the close of this report period, the material is being studied by the company; what use will be made of it cannot be determined at this time.

CASE NO. 123

Client No. 0257 was one of the first companies to subscribe to STRC services under the fee-paying program initiated in January 1966. It was, and remains, one of the largest and most active of all STRC clients, and for this reason was recently the subject of an in-depth staff review on what constitutes a good client/RDC relationship.

This client is a large company by dollar volume, number of employees, marketing area, and size and extent of R & D program. Although located in a neighboring state, it has been visited frequently and a personal relationship established between its staff and ours.

There are several factors which seem to contribute to the continued successful relationship between this client and STRC. In the opinion of the engineer servicing the account, these are, in descending order of importance:

1. The NASA data bank is the most complete information resource in existence on the type of work that this client is doing.

2. The client is a totally integrated company, in that it is concerned with every phase of production from the conversion of the raw materials through to the finished marketable product. It is therefore interested in everything pertaining to its product from basic theory to research management, production technology, and marketing.

3. This client has an extensive R & D program and the capability to assimilate and use the material supplied by STRC.

In the past year, this client has ordered a total of 142 documents from 9 searches and 10 updates. Some of the interest areas updated monthly have, with slight variations, been running for several years, a strong indication that they are considered very valuable by the company.

There is no way of assigning a monetary value to service for this client; it consists, apparently, in supporting and strengthening the entire R & D program, but the company does not divulge any information as to research projects or the use to which the material is put.

A P P E N D I X

* * *

E X H I B I T S

NORTH CAROLINA SCIENCE AND TECHNOLOGY RESEARCH CENTER

Research Triangle Park, N. C. 27709

P. O. Box 12235

Telephone: (919) 549-8291
TWX Number: 510-927-1804

STRC INFORMATION RESOURCES, OCTOBER 1, 1969

THE NASA INFORMATION FILE, containing at present close to 420,000 documents, has been growing at a rate of approximately 70,000 per year since 1962. It is composed of only 16% NASA-generated reports, the balance being reports, published and unpublished, collected from world-wide sources deemed pertinent to any phase of the aerospace program. Two journals abstract these varied articles and are published semi-monthly - International Aerospace Abstracts (IAA) and Scientific and Technical Aerospace Reports (STAR).

Available for: 1. Retrospective searches,
2. Custom-Tailored Interest Profiles.

THE DEPARTMENT OF DEFENSE FILE (TAB unclassified) dates from mid-1964 to the present, and contains approximately 72,000 documents collected by the Defense Documentation Center (DDC). These are abstracted in the journal U. S. Government Research and Development Reports.

Available for: 1. Retrospective searches,
2. Custom-Tailored Interest Profiles.

THE INSTITUTE OF TEXTILE TECHNOLOGY FILE contains approximately 33,000 documents from 1966 to the present. Articles are abstracted in Textile Technology Digest, which is published monthly with about 1,000 abstracts in each issue.

Available for: 1. Retrospective searches.

ENGINEERING INDEX, dating from January 1968 to the present, is a monthly review of over 3,500 technical journals published both in the United States and abroad. The plastics and electrical/electronics sections of the index cover approximately 350 journals with over 6,000 plastics abstracts and 12,000 electrical/electronics abstracts annually. Services will be expanded January 1970 to contain all accessions abstracted in the Engineering Index Monthly.

Available for: 1. Retrospective searches,
2. Custom-Tailored Interest Profiles,
3. Standard Interest Profiles.

CHEMICAL ABSTRACTS CONDENSATES, dating from mid-1969 to date, prepared by the American Chemical Society. CA Condensates tapes include the complete contents of Chemical Abstracts covering approximately 13,000 journals, plus extensive patent coverage. Service provided includes coverage of all issues, or, at the client's request, coverage of only the odd issues, or only the even issues. There are now approximately 250,000 abstracts appearing in Chemical Abstracts annually.

Available for: 1. Retrospective searches (as file accumulates),
2. Custom-Tailored Interest Profiles.

NC STRC
 SEARCH A4023
 TITLE - HYPERGOLIC MIXTURES
 NASA "A"
 NASA "N"
 BOTH PUBLISHED AND MACHINE TERMS
 FINAL HIT LIST ONLY
 8-27-69

SAL TERMS	
A - SPONTANEOUS IGNITION TEMPERATU	34
B - HYPERGOLIC PROPELLANT	63
C - HYPERGOLIC	115
D - SPONTANEOUS	289
E - MIXTURE	2154
F - COMBUSTION	3981

TOTAL SAL POSTINGS - 6636

SAL STRATEGY
 (A+B) + (C+E) + (D.F)

THESAURUS TERMS	
A - SPONTANEOUS COMBUSTION	33
B - HYPERGOLIC ROCKET PROPELLANTS	46

TOTAL THESAURUS POSTINGS - 79

THESAURUS STRATEGY
 (A+B)

Search Request via TWX

Exhibit A - 2

CONTENTS	CARD COLUMN	Machine Only	0	Total No. of Postings
Terms	1-30	Published Only	I	79
Oper	34-37	Both	Z	8/27/69
Pub. & Mach.	39	Other than NASA	J	0:18.80
Posting	73-80			79
And ()				
Or (+)				
COMMENTS:		TIME (Est.) - 20 SECS		

CONTENTS		CARD COLUMN			Total No. of Postings
Terms	.....	1-30	Machine Only	0	6636
Oper	.....	34-37	Published Only	1	8/27/69
Pub. & Mach.	.....	39	Both	2	0:32.50
Posting	.....	73-80	Other than NASA	3	111
			COMMENTS:		
			TIME (Est.) -		40 SECS.

Exhibit A - 4

TIME RECORD

CLIENT NUMBER _____ INTEREST AREA NUMBER _____ SEARCH NUMBER _____ DATE _____ ENGINEER _____

CLIENT _____ FOR: _____

SEARCH TITLE _____ IAA/STAR ISSUES _____

<u>ENGINEER'S TIME</u>	<u>LOAD SHEET TIME</u>	<u>KEYPUNCH TIME</u>	<u>SEARCH INFORMATION</u>
<u>Initial</u> <u>Date</u> <u>Time Spent</u>	<u>Initial</u> <u>Date</u> <u>Time Spent</u>	<u>Initial</u> <u>Date</u> <u>Time Spent</u>	<u>Date Run</u> <u>Postings</u> <u>Intersections</u> <u>No. of Hits</u> <u>No. of Terms</u>
			<u>Evaluated Hits</u>
<u>ABSTRACTS PULLED</u>	<u>RECORDAK PRINTING</u>	<u>HARD COPY PROCEDURES</u>	<u>MISCELLANEOUS</u>
<u>Initial</u> <u>Date</u> <u>Time Spent</u>	<u>Initial</u> <u>Date</u> <u>Time Spent</u>	<u>Initial</u> <u>Date</u> <u>Time Spent</u>	<u>Mail Expenses, etc.</u>
	<u>No. Pages Copied:</u>		
<u>No. Pages Xeroxed:</u>			



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RESEARCH TRIANGLE PARK, N. C. 27709

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Telephone: (919) 549-8291
TWX Number: 510-927-1804

PRICE LIST FOR STRC SERVICES

I.

<u>RETROSPECTIVE SEARCHES</u>	<u>ANNUAL SUBSCRIBERS (with \$ 5 00 minimum)</u>	<u>DEMAND CLIENTS</u>
<u>Single File Searching</u>		
National Aeronautics and Space Administration (NASA) (366,000 documents from '62)	\$ 60.00	\$ 75.00
Department of Defense (DDC) (65,000 documents from '64)	50.00	65.00
Institute of Textile Technology Digest (ITT) (30,000 documents from '66)	35.00	45.00
<u>Multi-File Searching</u>		
NASA + DDC	\$100.00	\$125.00
NASA + ITT	85.00	105.00
DDC + ITT	75.00	95.00
NASA + DDC + ITT	125.00	155.00

II.

<u>CUSTOM-TAILORED INTEREST PROFILES</u>	<u>ANNUAL SUBSCRIBERS (with \$500 minimum)</u>	<u>DEMAND CLIENTS</u>
<u>Twelve (12) Monthly Mailings</u>		
National Aeronautics and Space Administration (NASA)	\$120.00	\$150.00
Department of Defense (DDC)	100.00	125.00
Chemical Abstracts Condensates (CAC) (Biweekly)		200.00 (+ or -) for Odd or Even

III.

<u>STANDARD INTEREST PROFILES (from Engineering Index).</u>	<u>ANNUAL SUBSCRIBERS (with \$500 minimum)</u>	<u>DEMAND CLIENTS</u>
<u>Twelve (12) Monthly Mailings</u>		
Electronics/Electrical	\$ 80.00	\$ 80.00
Plastics	80.00	80.00

(Complete file available effective January 1, 1970)

IV.

DOCUMENTS

Documents requested from any search or interest profile tailored by STRC will be provided at their cost.

STRC will provide no document support for Standard Interest Profiles compiled from Engineering Index. Documents may be obtained by client from Engineering Societies Library, 345 East 47th Street, New York, New York 10017. An order blank is enclosed with each profile.

MAY 1, 1969

GRADUATE DEGREE CANDIDATE TIME RECORD

STUDENT NAME: _____ GDC NO.: _____

<u>ENGINEER'S TIME</u> Initial _____ Date _____ Time Spent _____	<u>LOAD SHEET TIME</u> Initial _____ Date _____ Time Spent _____	<u>KEYPUNCH TIME</u> Initial _____ Date _____ Time Spent _____	<u>SEARCH INFORMATION</u> DATE RUN _____ SEARCH NO. _____ POSTINGS _____ HITS _____ TERMS _____ INTERSECTIONS _____ EVALUATED HITS _____
<u>ABSTRACTS PULLED</u> Initial _____ Date _____ Time Spent _____ No. Pages Xeroxed: _____	<u>RECORDAK PRINTING</u> Initial _____ Date _____ Time Spent _____ No. Pages Copied: _____		<u>HARD COPY PROCEDURES</u> Initial _____ Date _____ Time Spent _____
<u>MISCELLANEOUS</u> Initial _____ Date _____ Time Spent _____			